Groundwater Resource Development Board (GWRDB)

Kathmandu, Nepal

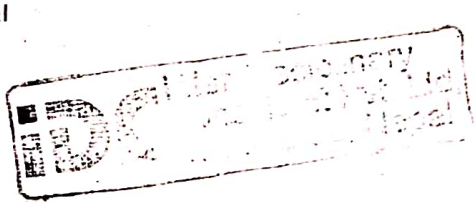
Inventory of Deep Tubewells in the Northern and Southern Groundwater District of Kathmandu Valley

FINAL REPORT

2013

Submitted by:

Inter Disciplinary Consultant Pvt. Ltd.
Kamalpokhari, Kathmandu, Nepal
PO Box: 13682



INVESTIGATION TEAM

Dr. Suresh Das Shrestha

Ms. JunuAdhikari

Ms. KabitaKarki

Ms. Sushmita Bhandari

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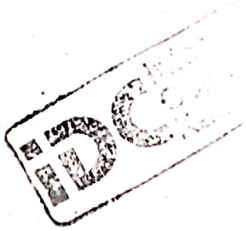

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Chapter 1

INTRODUCTION

1.1 Background:

Groundwater extraction from deep aquifers in Kathmandu valley started in the early 80s. Initially the extraction was limited to fulfill the requirements of few hotels and industries. Times have however changed, Kathmandu Valley which once consisted of three small sleepy towns and pockets of settlements have transformed into a mega metropolis with 5 municipalities and large number of settlements. All available surface water supply sources are utilized to optimum but which is still inadequate.

Ultimately with all the surface sources used up, groundwater sources are extracted to fulfill the demand. However in the absence of rules and regulations and implementations,the abstraction has become so rampant that no records are available as to how many wells have actually been drilled and where.

Northern GW district is identified as the most potential among the three groundwater districts in terms of groundwater resource and quality (JICA 1990). Thus it is only naturalthat KUKL has placed maximum number of extraction wells in five well fields extending from Balaju in the west to Bhaktapur in the east. Similarly, the southern Groundwater district is considered as the least potential among the three groundwater districts, recently however the number of deep wells has grown considerably.

Both the northern and southern GW districts constitute the peripheral parts of the valley with semi-rural environment. According the population census data, the Village Development Committees (VDCs)in the northern are the fastest growing in the valley, also major KUKL well fields are located in the northern side due to abundance of groundwater resource. The southern groundwater district in comparison has a slower growth rate as groundwater potential is considered relatively low. This however has not deterred property developers. Many housing projects are in the construction phase in the south. Due to existing infrastructures, most of these housing projects are getting clustered in and around the same areas thereby increasing the concentration of wells in small areas which may have an impact on overall groundwater production.

Inventory and constant update of the inventory help plan long term strategy for optimum groundwater development without stress on the resource itself.

1.2 Objectives

General Objective:

To determine the status of groundwater sources in the Northern and Southern Groundwater Districts of the Kathmandu Valley

Specific Objectives:

1. The detail inventory of all the groundwater extraction units in northern and southern groundwater districts of Kathmandu Valley
2. The details of extraction units, their utilization or operation in groundwater extraction
3. Workout of current status of groundwater extraction in the Kathmandu Valley

1.3 Scope of the work

- Collection of available related literature, reports and other information
- Location and identification of existing functional deep tube wells within the northern and southern districts of valley, which are being used for industrial, commercial including housing complexes, hotels, hospitals and recreational facilities and community purposes.
- Information collection on characteristics of located tube wells and associated aquifers.
- Assessment of potential impacts on land and environment, which would result from the present scenario of groundwater extraction
- Formulation of suitable regulatory measures for controlling over extraction.

Chapter 2

THE STUDY AREA

The study area is classified as Northern Groundwater District and Southern Groundwater District as per the classification of JICA 1990 (Figure 1).

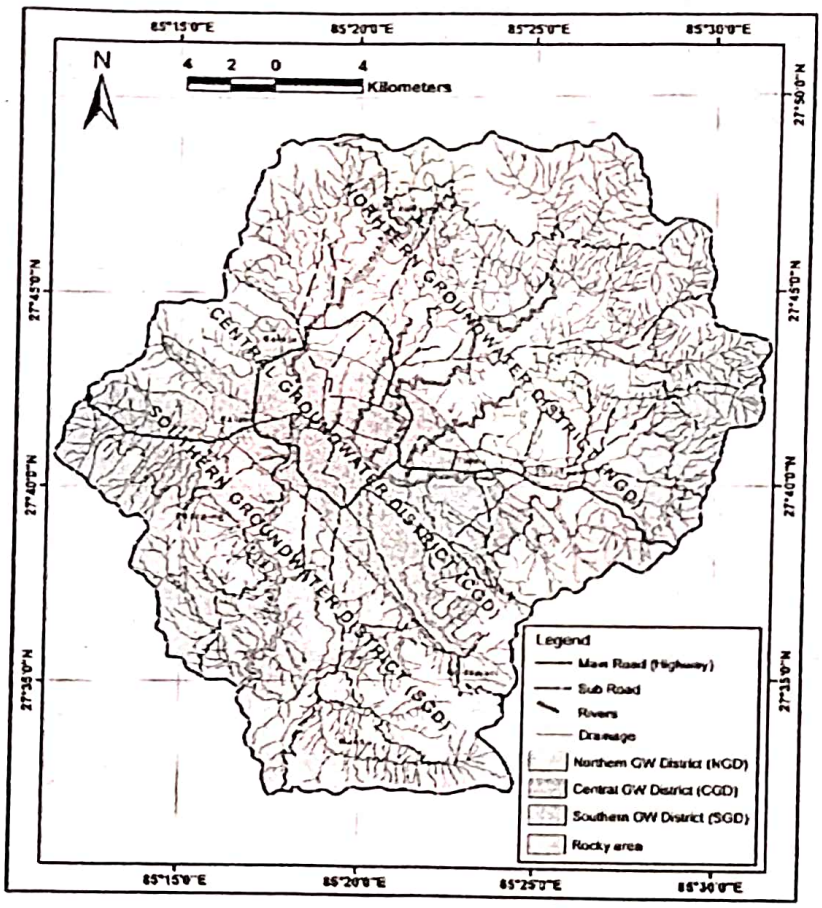


Figure 1: Groundwater Districts (JICA, 1990)

2.1 The Northern Groundwater District (NGD)

2.1.1 Location and Drainage Pattern

It is demarcated as the area north of Balajubypass, Lainchaur, GairidharaChowk, GaushalaChowk, Airport Gate, Gothatar and SallaghariBhaktapur (Figure.1). The elevation varies from about 1300 m to 1400 m. There are number of north south flowing streams

important among which are Bagmati, Visnumati andManohara. These rivers flow south to join the trunk River Bagmati and the rainage patternformed is dendritic.

This zone includes principal water supply well fields of NWSC; Bansbhari, Dhobi Khola, Gorkarna, Manohara and the Bhaktapur (West to East). It extends from Katunje in the East to Lamabazar in the West and Budanilkantha in the North to Pashupati in the South. The deposits are composed of unconsolidated, highly permeable materials of micaceous sand and gravel. The unconsolidated coarse sediments are as thick as 60m, however several impermeable fine layers interbed with these coarse sediments. This coarse sediment is the main aquifer of the valley. The quality of the groundwater is characterized by low electrical conductivity such as 100 to 200 micro-simens/cm and Transmissivity of the aquifer ranges from 83 to 1963 m^2/day. Few wells in this area had artesian outflow at their time of construction.

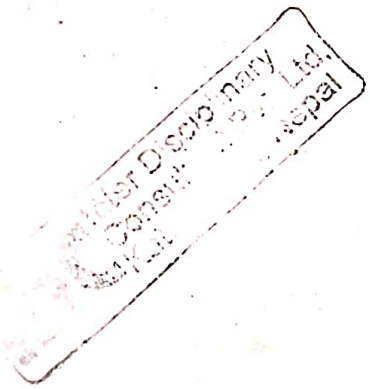
Besides shallow and deep groundwater system, surface water sources like springs and rivers are other water sources in the area.

2.1.2 Groundwater use and prospects:

Northern Groundwater District is considered the most promising with respect to groundwater resource. Similarly the quality of springs is generally considered good. KUKL uses surface as well as groundwater for public water supply. Groundwater is one of the principal sources of drinking water in the study area. Deep tube wells are installed in different locations, like in Mulpani, Gokarna, Bode, Gongabu and Bansbari etc. Most of KUKL extraction wells are located in 5 well fields of Northern groundwater district.

The aquifers in NGD is considered to have good discharge due to favorable surface and subsurface geology consisting of coarse grained fluvial deposits from north. The region consists of terraces and hillocks of sand deposits. Kalimati(Black Clay) layer so prominent in the south and which divides the shallow aquifer from the deep, is thin or even nonexistent in the north. The aquifer at places attains the thickness of more than 60m. Due to shallow aquifer depth, groundwater quality, in terms of chemical and physical, is relatively better compared to the south.

Easy access to water has resulted in rapid urbanization in these areas. The top five fastest growing VDCs in terms of population growth in the valley all lie in the northern groundwater district (CBS 2001). The result has been fast changing landscapes. The sand hillocks that recharged groundwater naturally have disappeared in the last few years or are in the process of disappearing due to extensive sand mining. Sand mining has also been rampant in the river beds lowering the river bed and exposing the fine grain layers underneath. This may have resulted in the decrease in natural infiltration or recharge in the area as well as decrease in groundwater resource. At the same time groundwater abstraction is on increase from growing number of KUKL deep tube wells and also from increasing number of housing colonies, commercial abstraction by tankers etc. Rapid increase in deep tube wells (Fig.6 and 7) is the evidence of growing abstraction, so much so that monitoring of deep wells indicate lowering of 2.5m/yr. in piezometric level. However there must be substantial recharge from the surface and from the periphery, as indicated by seasonal fluctuation in piezometric level data. The fluctuation may have been due to rapid abstraction from the wells in dry period and monitoring works in the abstraction wells.



2.1.3 Groundwater abstraction:

Though there are large number of deep wells, most of them do not maintain database. So their current status regarding abstraction volume, discharge is not known.

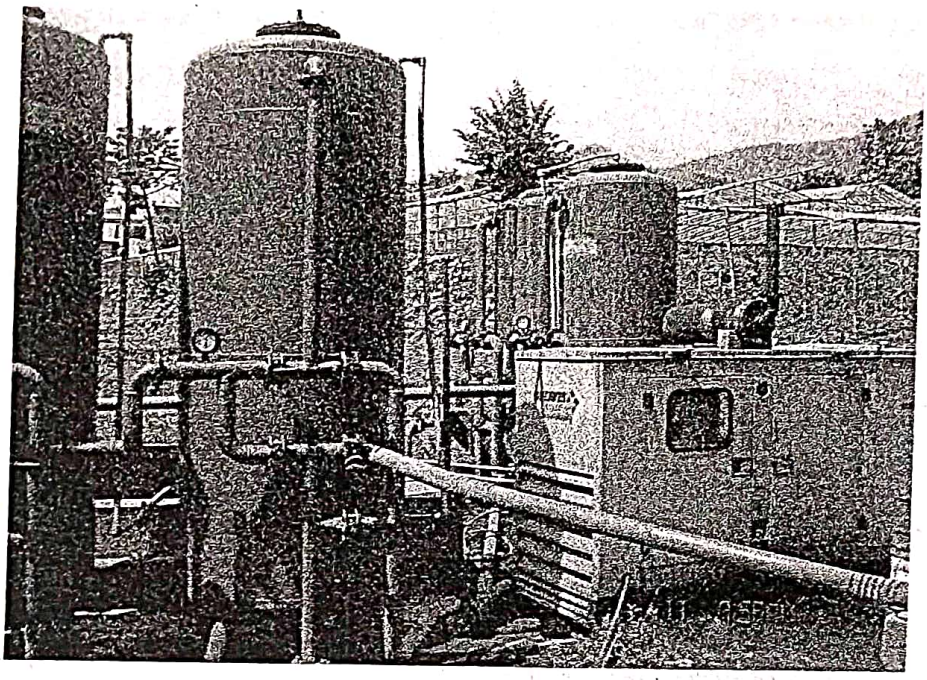


Plate 1 Showing the groundwater extraction and treatment facilities

2.2 Southern Groundwater District (SGD)

2.2.1 Location and Drainage Pattern

The Southern Groundwater District lies in the southern part of the Kathmandu Valley. It is demarcated as the area south of KalankiChowk, Ekantakuna, Mahalaxmithan, Satdobato and Harisiddhi. The elevation varies from about 1280 m to 1350 m. Drainage pattern is dendritic unlike centripetal drainage pattern of whole Kathmandu valley.

This area is characterized by a basal gravel of low Transmissivity overlain by a thick impermeable clay formation. The aquifer is not well developed and is recognized mainly along the Bagamati River between Chobhar and Pharping. Most of the wells are located in the Northern ground water district as this area has the best aquifer conditions. Most of the private wells are located in central part of the valley where water contain high quantity of ammonia and nitrogen and are mainly used only for sanitary purposes (JICA, 1990).

2.2.2 Groundwater use and prospects:

Southern groundwater district is referred to as non-potential in terms of groundwater resource and quality. This area has not seen comparative growth and is still mostly farm areas with little population, thus there only few deep wells. This is however changing fast. The less populated farm areas have suddenly seen attraction for real estate developers as number of housing projects is under way in southern part of Lalitpur district. Similarly the southern part is also seen as a potential start point for fast track road joining Kathmandu Valley with the Terai in the southern part of Nepal, Similarly a tunnel project between Kathmandu and Hetauda is also proposed to start from this area. The concept of outer ring road is also expected to fuel migration to the south of the valley so far remained inaccessible due to lack of roads.

The area has large number of spring sources widely distributed in the carbonate rocks in the hills. Most of the spring sources are tapped by private water vendors or the community for water supply. Notably among these are the Godavari community water supply and Matatirtha water supply. Many of these spring sources are tapped for bottled water industry especially in Matatirtha area. Shallow water wells are drilled by private vendors to supply water in tankers. The oldest state run water supply uses spring sources is from Shesh Narayan and supplies estimated 4MLD everyday. The area also has two of the oldest deep wells (PH1 and PH2) still being used for water supply by KUKL. Comparatively more water is extracted from rock aquifers either from spring sources or drilling

2.2.3 Groundwater abstraction

Due to less potential in terms of water supply, southern groundwater district have only limited number of deep wells for water supply. Discharge in wells so far is sufficent but users say, the discharge is actually decreasing even when number of deep wells are few.

Chapter 3

GEOLOGY AND HYDROGEOLOGY

3.1 Literature review

Number of studies have been carried out in the valley related to groundwater. Initially the works were related to geology, hydrogeology, groundwater quality and resource. Later on the studies focused mainly on aquifer parameters, policy and resource distribution networks etc.

Literature and data for the study were primarily collected from reports of the past studies. Mostly data were collected from the following reports of studies carried out in the past.

- Japan International Cooperation Agency (JICA), 1990. Groundwater Management Project in the Kathmandu Valley
- BGR (1998). Hydrogeological Conditions and Potential Barrier Sediments in the Kathmandu Valley
- Japan International Cooperation Agency (JICA), 1990. Groundwater Management Project in the Kathmandu Valley,
- Metcalf & Eddy Inc (1999), Urban Water Supply reforms in the Kathmandu Valley, Groundwater Monitoring Porgram.
- Stöcklin and Bhattarai (1977) and Stöcklin (1981), Detail geological studies in the Central Nepal with aerial photo interpretation.
- Rao, G.K. and Gautam, R. (1991) Groundwater Potential of the Kathmandu Valley. Journal of Nepal Geological Society, Vol. 7, Page 39-48.
- Engineering and environmental Geological Map of the Kathmandu Valley, Published by Department of Mines and Geology.
- Shrestha et al., (1998) Engineering and environmental geological map of Kathmandu Valley, scale 1:50,000. Department of Mines and Geology, Nepal

3.2 Northern Groundwater District

3.2.1 Geology

Geologically the northern groundwater district is comprises of two units: the basement rocks and the overlying Quaternary basin fill sediments.

3.2.1.1 Basement Rocks

The Northern and North-Eastern parts of the basin is underlain by the basement rocks of granites, gneisses, schist, migmatites of the Shivapuri Gneiss Injection Zone which show greater degree of weathering and thus gives rise to large amount of alluvial and colluvial in the form of cone and fan. The hills to the East and West of the Valley are mainly composed of phyllites, sandstones and limestone (Figure 2)

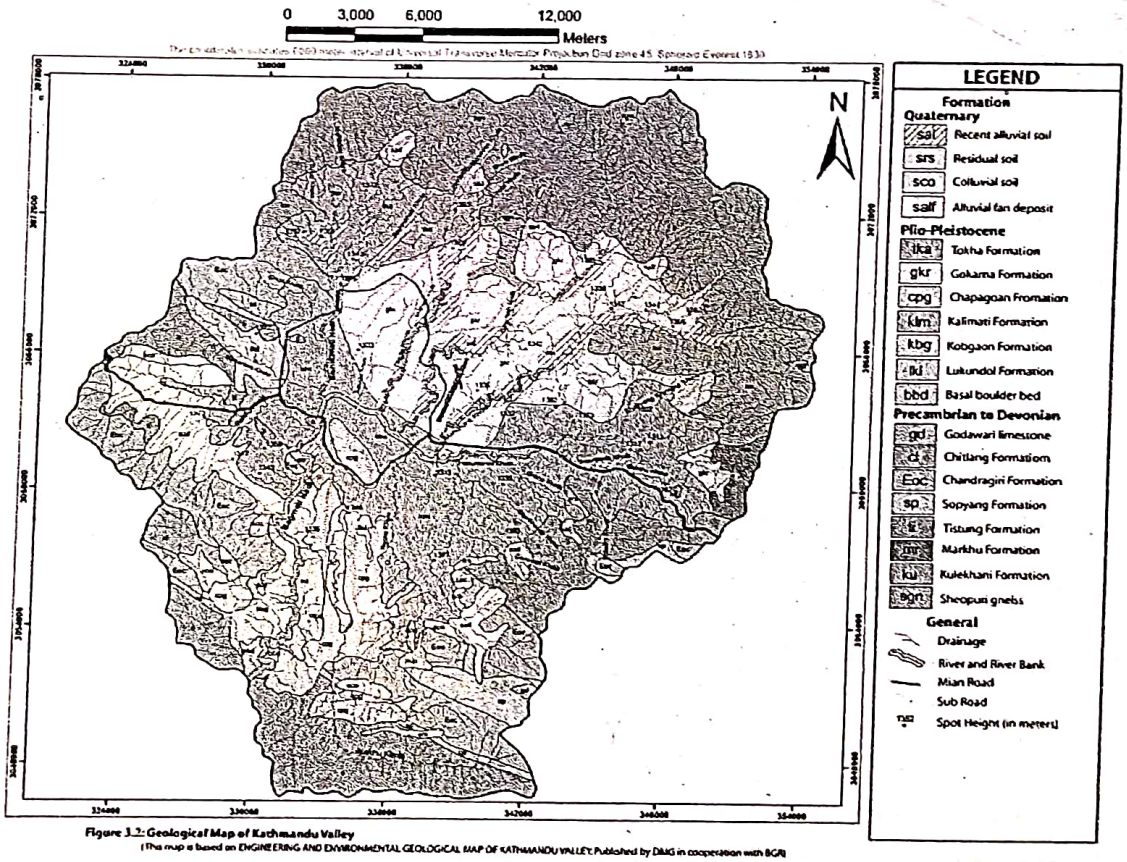


Figure 3.2: Geological Map of Kathmandu Valley
(This map is based on ENGINEERING AND ENVIRONMENTAL GEOLOGICAL MAP OF KATHMANDU VALLEY, Published by DMG in cooperation with BGR)

Figure 2: Geological Map of Kathmandu Valley (DMG, 1998)

3.2.1.2 Quaternary Geology

According to the first Engineering and Environmental Geological Map of the Kathmandu Valley the Neogene to Quaternary fluvio-lacustrine deposit of the Valley is divided into

Quaternary, Unconsolidated sediment and Plio-Pleistocene, Slightly Consolidated sediments (Table 1 and 2, Figure 2).

Table 1: Classification of Quaternary Unconsolidated Sediments of the Kathmandu Valley (DMG, 1998)

S. N	Formation	Description
1.	Recent Alluvial Soil (sal)	Recent sediments of flood plains and lower alluvial terraces. In the Northern part, sand and gravel deposits up to boulder size. In central and southern part, clay, sand and fine gravel. Hydro-logically the formation is high potential of groundwater with periodic change of shallow groundwater level, high infiltration and high risk to pollution of groundwater and surface water.
2.	Residual Soil (srs)	Humicsilty loam to sandy gravels of thickness 1-3 m, at places and occur on slopes. High Infiltration and potential for groundwater.
3.	Alluvial Fan Deposit (salf)	Gravel, sandy gravel, sand and silt. Thickness increases towards the center of the fan. Finer grained material towards the margin of the fan. High infiltration of surface water and Perched water table may be present.

Table 2: Classification of Plio-Pleistocene Slightly Consolidated Sediments of the Kathmandu Valley. (DMG, 1998)

S.N	Formations	Description
1	Tokha Formation (tka)	The formation mainly consists of dark grey clay, brownish grey sand and poorly sorted, sub angular to rounded sandy gravel with occasional peaty clay and lignite layers. The thickness of the formation is up to 200 m or more. This formation may act as good aquifer materials for the groundwater abstraction from shallow depth. The formation is mostly high permeable.
4	Gokarna Formation (gkr)	It comprises light grey; fine laminated and poorly graded silty sand, intercalation of clay of variable thickness as well as in upper part Thimi diatomite (1m) present. The total thickness is up to 300 m and more. The sediment of this formation is considered to be fluvio-deltaic facies. In the contest of hydrology, the formation is medium groundwater potential and moderate to high groundwater infiltration.
5	Kalimati Formation (klm)	The formation is exposed in the central part of the valley around the main cities of Kathmandu, Lititpur and Bhaktapur. It consisits of grey to dark silty clay and clayey silt, at places calcareous nature and phosphate mineral (vivianite). Organic clay, fine sand beds and peat layers are common. Occasionally lignite seams upto 20m is also occurs. In Kharipati are quartzite and biotite schist boulder beds with

		sandy gravel and minor clayey and sandy silt layers are present. The total thickness of the formation is 450 m or more. This formation shows purely a lacustrine facies and it acts as an aquiclude or aquitard material having extremely low permeability.

3.2.2 Hydrogeology

The hydrogeology of the area is governed by various factors such as the precipitation over the area, rate of infiltration, topography, geology and drainage networks of the area. The granular deposit in Northern part is generally poorly sorted.

3.2.2.1 Hydro-Geological Formation

JICA, 1990, divided the sediments of Kathmandu Valley into six hydrogeological formations (Formations A, B, C, D, E and F) of which northern groundwater district consists of formations A, B, E and F.

Formation A

The formation consists of river deposits, talus deposits, fan deposits, and top soil. This formation sometimes forms a shallow aquifer and is found all over the flat plain of the valley. The deposits in the North are sandy.

Formation B

This formation consists of arenaceous deposits or intermediate types of arenaceous distributed in the Northern part of the valley and form the main aquifer of the Northern part of the Kathmandu valley.

Formation E

This formation consists of weathered basement rock, which overlies basement rocks. This formation has a very small capability as an aquifer.

Formation F

This formation consists of basement rock, and usually forms an aquifuge (hydro-geological basement).The northern part of the valley mainly consists of unconfined aquifer zone (Ramesh Gautam and G. Krishna Rao, 1991).

3.2.2.2 Unconfined aquifer zone

These types of aquifer zones lie at north of Maharajgunj and Boudha and west of Gorkarna extending up to western and northern foot hills of the valley. The area between the Manohara and Bishnumati Rivers has been classified as interbedded aquifers and treated as an unconfined aquifer zone (Anon, 1988). Medium to coarse grained sand, gravelly sand and silty sand constitute the major aquifer materials forming unconfined aquifers (Figure 3).

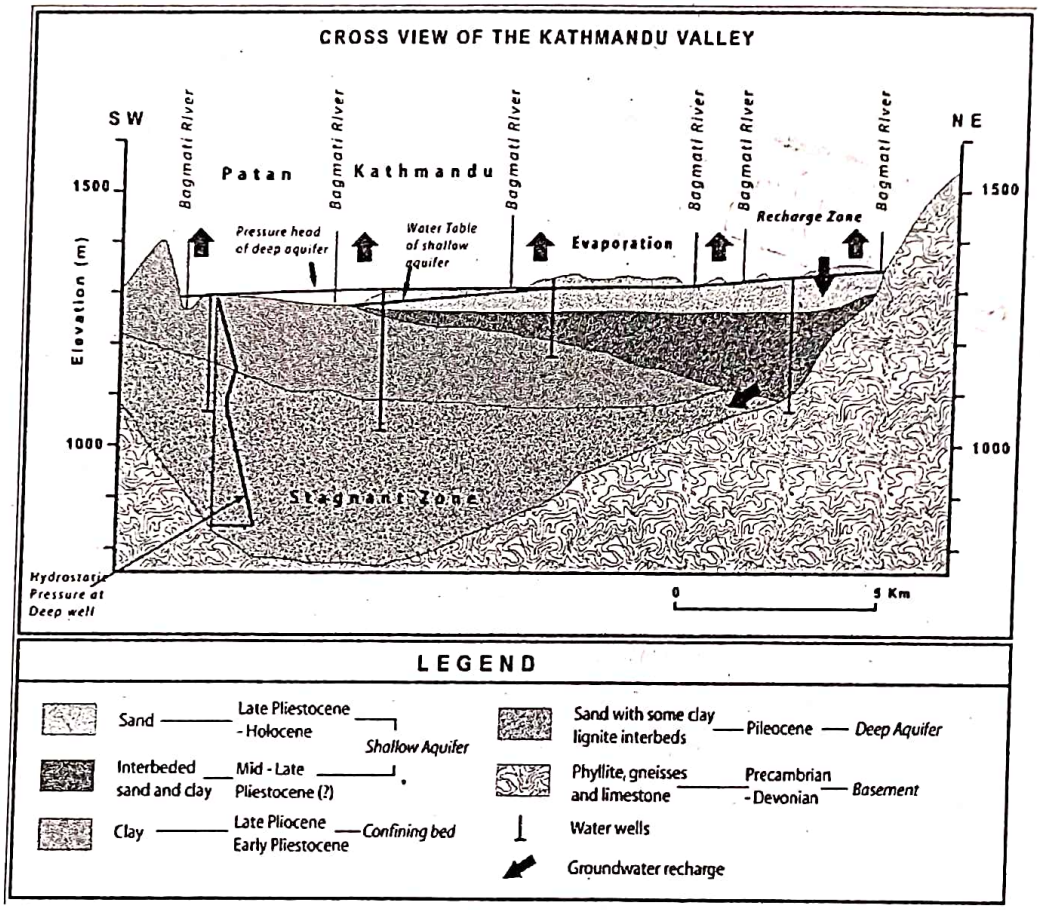


Figure 3: Cross sectional view of subsurface geology and hydrogeological system of the Kathmandu Valley after Cresswell.

3.3 Southern Groundwater District:

3.3.1 Geology

Geologically the southern groundwater district is also composed of two units: the basement rocks and the overlying Quaternary basin fill sediments.

3.3.1.1 Basement Geology

The hills to the South of the valley are composed of slates, metasandstones, quartzites, siltstones, shales and crystalline limestone belonging to Paleozoic Phulchouki Group. (Table 1 and Figure 2).

According to the Engineering and Environmental Geological Map of Kathmandu valley, the southern district consists of Quaternary Unconsolidated sediment and Plio-Pleistocene slightly consolidated sediment (Table 2 and 3, Figure 2).

3.3.1.2 Quaternary Geology

The southern district of the Kathmandu basin consists of thick succession of fluvial and lacustrine sediments of Plio-Pleistocene to Holocene epoch. These sediments are derived from the surrounding hills. The individual beds of the fluvio-lacustrine deposits are gently inclined to about 2-9° due North at the southern margin of the Basin (Sah et al., 1997). Thick Kalimati beds of thickness 200m is the prominent layer in the south.

Table 3: Holocene sediment distribution in the southern part of the Valley.

S.N	Formation	Description
1	Recent Alluvial Soil (sal)	Recent sediments of flood plains and lower alluvial terraces. In the Northern part, sand and gravel deposits up to boulder size. In central and southern part, clay, sand and fine gravel. Hydro-logically the formation is high potential of groundwater with periodic change of shallow groundwater level, high infiltration and high risk to pollution of groundwater and surface water.
2	Residual Soil (srs)	Humicsilty loam to sandy gravels of thickness 1-3 m, at places and occur on slopes. High Infiltration and potential for groundwater.
3	Colluvial Soil (sco)	Inhomogeneous deposit at footslopes with constituents of humic clay silt and sand, at places boulders. Variable thickness>1 m, increasing towards the center of the deposit. High Infiltration and low potential for groundwater.
4	Alluvial Fan Deposit (salf)	Gravel, sandy gravel, sand and silt. Thickness increases towards the center of the fan. Finer grained material towards the margin of the fan. High infiltration of surface water and Perched water table may be present.

Table 4:Classification of Plio-Pleistocene Slightly Consolidated Sediments in the southern part of Kathmandu Valley. (DMG, 1998)

S.N	Formations	Description
1	Chapagoan Formation (cpg)	It consists of sub-rounded to rounded silty sandy gravel, occasionally with boulder beds sometime with thin (<1m) clayey silt and silty sand, and at places lignite pockets. The total thickness is up to 110 m. High ground water potential. Moderate to high permeability. Groundwater level is moderately deep and highly vulnerable to groundwater pollution. The formation is potential for groundwater recharge.
2	Kalimati Formation (klm)	The formation is exposed in the central part of the valley around the main cities of Kathmandu, Lititpur and Bhaktapur. It consists of grey to dark silty clay and clayey silt, at places calcareous nature and phosphate mineral (vivianite). Organic clay, fine sand beds and peat layers are common. Occasionally lignite seams upto 20m is also occurs. In Kharipati are quartzite and biotite schist boulder beds with sandy gravel and minor clayey and sandy silt layers are present. The total thickness of the formation is 450 m or more. This formation shows purely a lacustrine facies and it acts as an aquiclude or aquitard material having extremely low permeability.
3	Kobgoan Formation (kbg)	It exposed along the western bank of the Bagmati River and NakhuKhola in the southern part of the valley around Yutiki, Pharping, Bansbari and TikaBhairab area. The formation consists of light grey to grey laminated fine sand, occasionally with sandy clay, silty sand and sub rounded to rounded, poorly graded gravel. The thickness is up to 50 m or more. The formation is moderate groundwater potential with moderate to deep groundwater level and has moderate to high permeability.
4.	Lukundol Formation (lkl)	It is exposed around the Sunakothi, Bungmati, Khokana and SaibhuBhaisepati area. It is composed of semi-consolidated sandy, clayey silt interbedded with gravel and clayey sand, peat and lignite of upto 3 m thickness. The total thickness of the formation is up to 80 m. The formation is low ground water potential with deep groundwater table and has low permeability.
5.	Basal Boulder Bed (bbd)	It is the oldest basin fills sediments which unconformably overlie the basement rock of the Valley. The formation is exposed at the south western part of the valley near KatuwalDaha around the Bagmati River. It consists of mainly of compact boulder conglomerate mixed with silt and sand. Boulders are of quartzite, granite,

		gneiss and meta-sandstone. The thick of this formation is up to 300 m. It has High groundwater potential and permeability.

3.3.2 Hydrogeology

The area consists of hard rock as the hydrological basement and unconsolidated soft sediments overlying the basement floor- includes, gravel, sand, silt, clay, peat and lignite brought from the northern hills. Northern and Northeastern part of the valley are the main source of valley sediments, hence thickness of these valley sediments gradually increases towards South and reaches maximum value in the central and Southern part. Though considered least potential among the three groundwater districts, the region has witnessed growth in large number of housing colonies and mineralwater, bottled water industries and abstraction points for tankers in the valley.

3.3.2.1 Aquifer settings

Thick basal gravel beds overlain by Kalimati Formation forms the principal deep aquifer horizon in the south, similarly carbonate rocks surrounding the hills in the south may also be potential hard rock aquifers as evident from large number of natural springs emerging from the basement rocks.

3.3.2.2 Rock Aquifer

The southern, southeastern, and the southwestern part of the valley are covered by inter bedded limestone, sandstone, shale, and siltstone. These rocks are highly jointed, fractured and porous (limestone terrain). Under intense weathering process, the carbonate rocks become favorable for the formation of groundwater reservoir with the development of underground drainage system. Some industries and institutions have benefitted from the rock aquifers. Number of mineral water industries as well as bottled water industries is evidence of this, The areas along the foothills of the southern part of the valley like Pharping, Thapagaun can be considered as the rock aquifer zone.

Chapter 4

DATA ACQUISITION

The data acquisition for the inventory involved following steps:

1. Primary data collection
2. Secondary data collection
3. Data verification and analysis

4.1 Primary data collection

Though most of the inventory works is based on secondary data sources, number of sites identified was visited for mainly GPS coordinates and also to verify other parameters mentioned in the secondary data.

4.2 Secondary data collection:

Data for well inventory were collected from drilling agencies like Asian Drilling Company, Nissaku drilling and National drilling company (NADCO) and Department of Irrigation (DOI). Distribution of wells in northern and southern district is shown in the Figure 4.

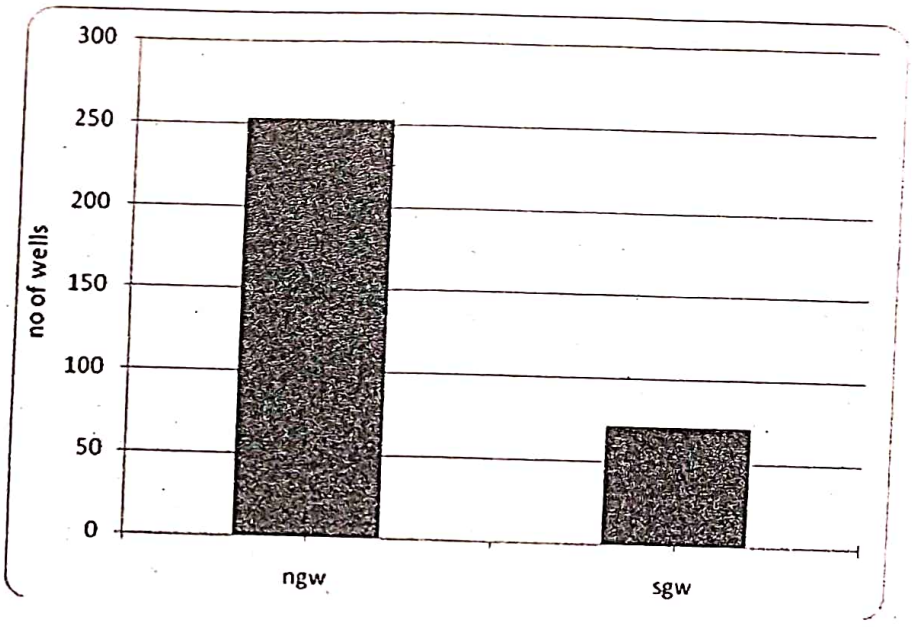


Figure 4: Number of wells in Northern and Southern Groundwater Districts

4.2.1 Northern Groundwater Districts

In 1989, the numbers of wells were reportedly 60 including 45 private wells. In 2000, Metcalf and Eddy reported 86 wells in operation including 43 NWSC operated wells out of 103 total wells drilled (Table 5).

Table5: Wells in the Northern Groundwater District

Groundwater District	Total # wells		# wells in use		# wells out of use	
	NWSC	Others	NWSC	Others	NWSC	Others
Northern	57**	46	43	43	14	3

source: Metcalf and eddy, 2000

Note:

** The Northern District has five well fields: Dhobikhola, Bansbari, Gokarna, Bhaktapur and Manohara

By 2010, there were 218 reported wells still the well in use and unused isn't known.

Form the present study so far information on 253 deep wells has been collected(Figure 4). The location of these wells is given in Figure 6 and AnnexI. The actual number of deep wells

may be much higher. Growth of wells in the northern district is shown in Table 6 and Figure 5.

Table 6: Growth of well in the Northern Groundwater District

S. N.	Year	Total wells drilled (in use)	Well category			
			KUKL	Industries	Goven/ Embassies	Hotels
1.	1989	47	30	2		5
2.	1992	50	30	3	1	5
2.	1999	117	46	4	5	17
3.	2010	188	57			

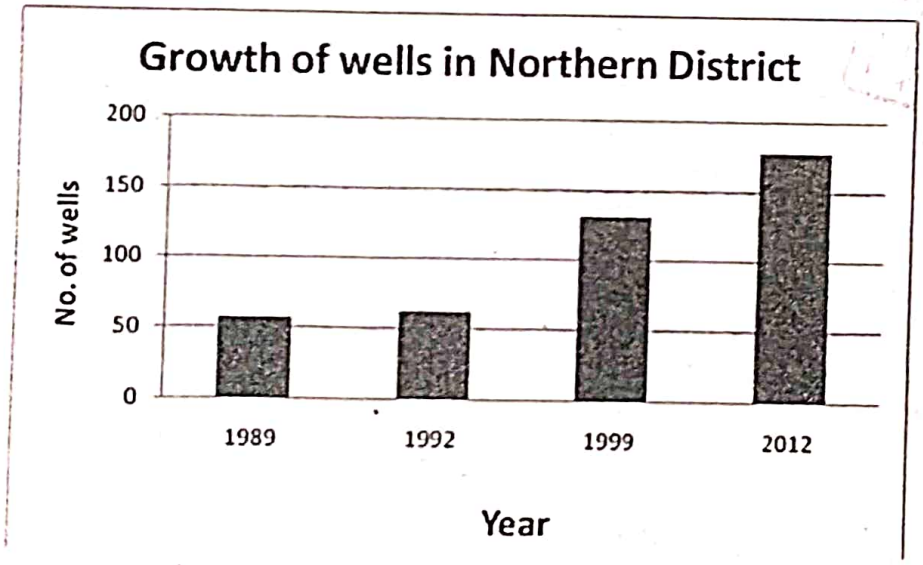


Figure 5: Figure showing the growth of wells in Northern Groundwater District of Valley

Distribution of Wells

The distribution of deep wells in the Northern Groundwater District is as shown in Figure 6.

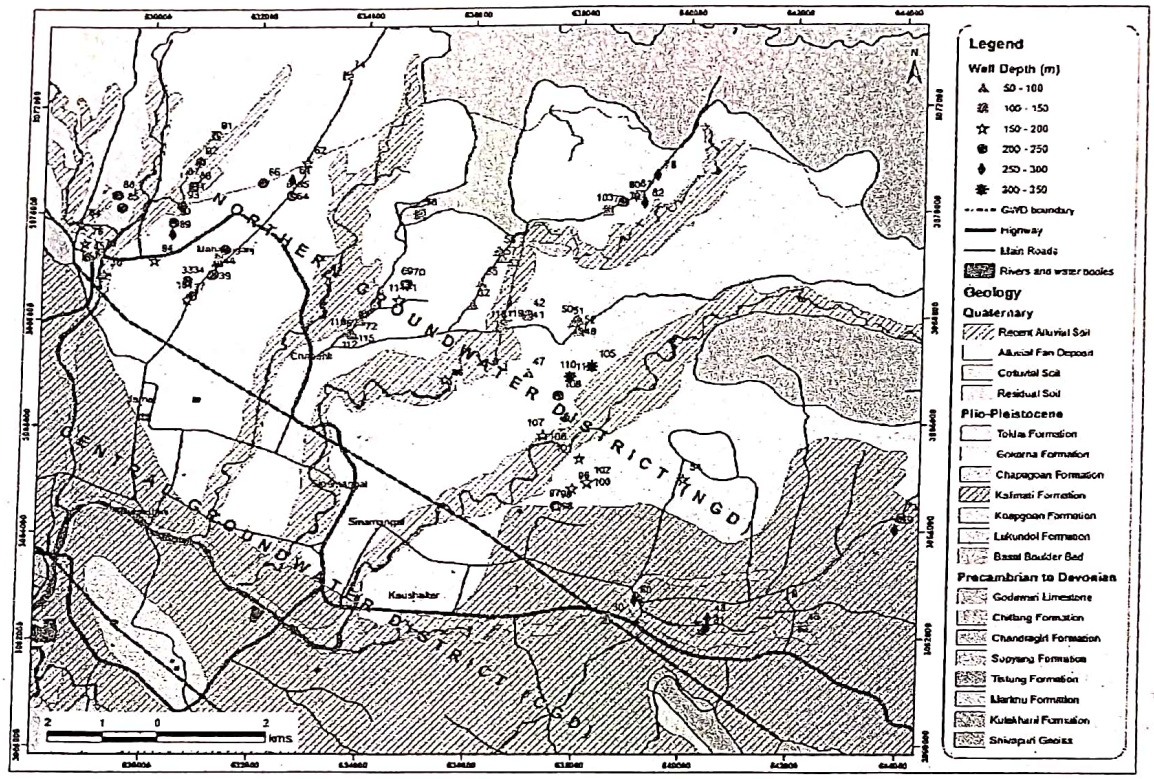


Figure 6: Distrubution of deep wells in the Northern Groundwater District.

4.2.2 Southern Groundwater District (SGD)

Until few years back, Southern Groundwater District (SGD) had the least number of deep tube wells compared to northern groundwater district. For the present study, information on 72 deep tube wells have been collected from the Southern Groundwater District. Out of this 72 deep tube wells, 14 deep tube wells belong to KUKL (for water supply purpose), 7 are of MWSDB (for monitoring purpose) and rest belong to private sectors and institutions like industries, embassies, academic institutions, hospitals, and government agencies. The collected data also shows that there is yearly increase in the number of the wells in SGD. In 1988-1989 the numbers of the wells constructed were reportedly 13.

In 2000, Metcalf and Eddy reported only 14 wells in operation including 4 NWSC operated well (Table 7).

Table 7: Tube wells in the Southern Groundwater District of the Kathmandu Valley

Groundwater District	Total # wells		# wells in use		# wells out of use	
	NWSC	Others	NWSC	Others	NWSC	Others
Southern	4	10	4	10	0	0

source: Metcalf and eddy, 2000

Note:

††P The Southern District has one well field: Pharping

From the present study information on 72 deep wells have been collected so far, but date of construction is known for only 38 of them. The actual number of deep wells may be much higher. Growth of wells in the southern district is shown in Table 8.

Table 8: Growth of well in the Southern Groundwater District

S. N.	Year	Total wells drilled (in use)	Well category			
			KUKL	Industries	Goven/ Embassies	Hotels
1.	1989	13	5	6		
2.	1992	14		1		
3.	2000	14		3	1	1
4.	2012	72	4	3		

Though the government had tried to implement few rules and regulation regarding the deep well construction, drilling is entirely a business deal involving the drilling company and the client. Few records are kept. Therefore the actual number of wells is bound to be much higher than the present collection. Especially as all shopping complexes, housing complexes, hospitals and nursing homes, hotels, embassies INGOs, NGOs, government institutions use plenty of water and which cannot be fulfilled only by municipal water supply. The growth of the drilling wells had increased rapidly within very short time after 2000(Figure. 7)

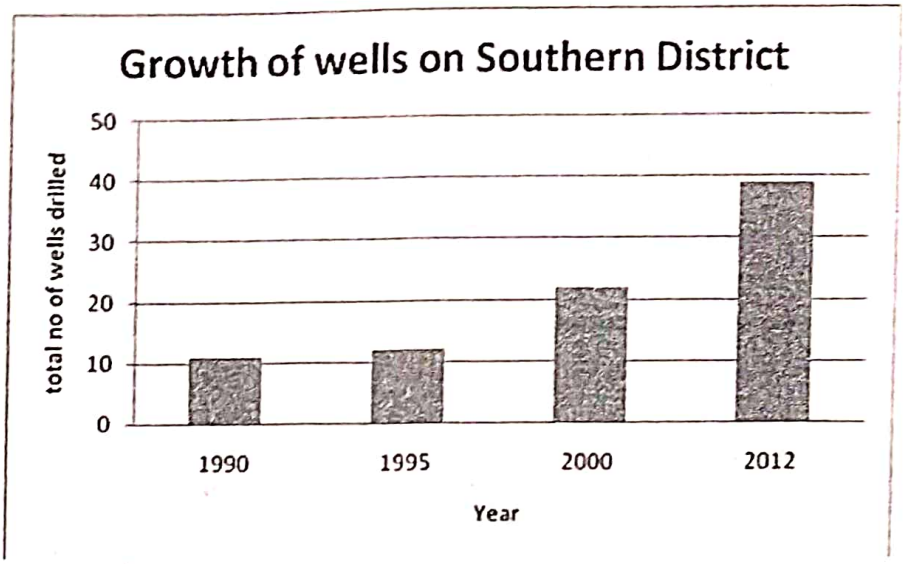


Figure 7: Growth of wells in the Southern Groundwater District.

4.3 Data verification

Number of parameters mentioned in the inventory table were verified during the field visit. These mostly included function of the wells, well diameters and well depths, number of wells in the sites. However due to lack of proper documents, verification were mainly done based on the memory of the management and the owners of the wells

Chapter 5

DATA ANALYSIS AND INTERPRETATION

5.1 Northern Groundwater District:

5.1.1 Surface Water Sources:

A study carried out in 1999 revealed 11 water supply systems (9 in Kathmandu and Lalitpur, 2 in Bhaktapur) were in operation (MPPW,1999). The system supplied 105.3 MLD in wet season (88.3% surface water, 11.7% groundwater) and 70.8 MLD in dry season (65% surface water and 35% groundwater). Many VDCs in the periphery of the valley have tapped spring sources in the foothills to supply water in the respective VDCs. This is observed in many locations including Sundarijal area.

5.1.2 Ground Water Wells:

Though under the groundwater policy recently introduced for Kathmandu Valley by Kathmandu Valley Water Supply Management Board (KVWSMB), all groundwater abstraction units are required to obtain license except for wells used for domestic uses. However so far only about 300 have obtained license, Therefore the actual number of wells is bound to be much higher than the number presented in the data base. The data (Annex I, Figure 8) shows that the numbers of wells constructed in the recent years are very low. This may be quite different from the actual scenario. This indicates that all the data aren't yet collected and this data gives the misleading interpretation of decreasing number of well construction in recent year.

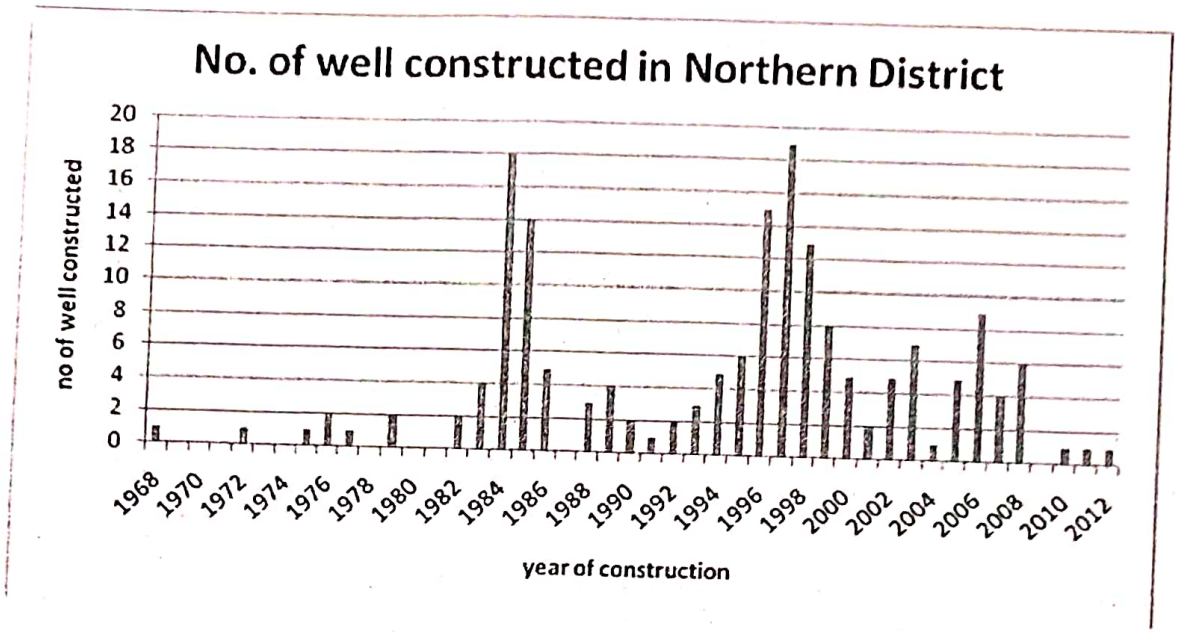


Figure 8: Figure showing the number of wells constructed in the particular year in Northern Groundwater District

5.1.3 Distribution of Wells

Till few years back most of the deep wells were concentrated in NGD compared to SGD owing to the favorable hydrogeological condition with high discharge, good water quality and aquifers lying at shallow depth. The collected data shows 252 well are located in the study area which however is less than in the central groundwater district.

5.1.4 Drilling depth

The drilling depth of the wells in the area ranges in depth from 50m to 338m at DK3b at Dhobi Khola. The shallow well of under 50m lies at number of unidentified locations at Boudha.

5.1.5 Screen Thickness and Static Water Level

The thickness of screen ranges from 9m to 156m (156m in Balaju Industrial Area and 9 m at KUKL Kapan), the majority of screen thickness ranges in between 30-55m. Screen thickness is less In Kapan,Mahankal, Gokarna and Bode area whereas high in Balaju,Gongabu area. The static water level (swl) of the area ranges from artesian condition to 93.3m below ground

level (bgl). Two artesian well present in the northern area are at Gongabu Bus Park and at Balaji Investment Pvt ltd Panipokhari.

40 wells have screens located in shallow aquifer zone. Among them only 4 wells (Airport, Gongabu, Kapan and Mahankal) constructed in the year of 1986 and 1984, had been depending or using only the shallow aquifer, rest 38 wells had been using shallow as well as the deep aquifer. The Airport-Kapan-Mahankal lies in the Gokarna Formation of Kathmandu Basin. The use of multi aquifer may have negative influence in shallow groundwater dynamics of the area.

5.1.6 Discharge

The discharge of the wells in the northern districts varies from 0.33l/s (ShyalpaMonastry, Kapan) to 46.32l/s (KUKL, Gongabu) (Annex I). Wells in Gongabu, Bode area have relatively higher discharge. Similarly, Balaju and Bansbari area have relatively lower discharge. Mulpani area has higher discharge but the same area, wells have also lower discharge.

5.1.7 Water Table Monitoring

Newspapers regularly carry news/articles on lowering of water table in Kathmandu Valley. Reports from earlier studies also mentions drastic lowering of water table in the valley. Reportedly the water table has fallen between 6- 15 meters in 1999-2000 in Manahara, Goakarna ,Bansbari and Bhaktapur wells, (MPPW,1999). Other studies have reported lowering of groundwater level by 2.5m/yr (MPPW, 2002,). Systematic and regular monitoring of water table has not been carried out till recently. GWRDB carried out static water level monitoring of 37 wells and pumping water level monitoring of 8 deep wells in the valley for Melamchi Water Supply Project. The program was suspended after 5 years of regular monthly monitoring works, the result of the monitoring works are present in Annex II.

The monitoring data shows static water level fluctuations in deep wells so far referred to as fossil water. The monitoring data also shows steady decline in average water level every year in most of the wells. However the decline is less compared to the reported value. Altogether

17 deep wells were monitored in the northern groundwater district. Maximum lowering of water table has occurred in the well BB1 (Table 9) which has its water table standing at 48.08 mbglin 1984 and which had lowered to 74.86 m bgl in 2000A.D. and further lowered to 82.5 m bgl in 2005A.D. The maximum average decline is 1.7m/yr.

Some wells have basically remain unchanged since "84, wells DK1, DK2 and DK8 in Kapan and Mahankal area, have basically remained same with very low decline ,since 84, in terms of water level. Wells DK2 and DK8 are probably recharged from monsoon rains, DK 2 can be referred to as shallow well. Groundwater lowering is also reported in Duwakot, Phutung and Danchi area of northern groundwater district. A recharge well and one observation wells in Mulpani area have moderate changes of about 17 to 18m of lowering in 25 yrs.

Table 9: Average yearly water table in the wells of NGD

S.N	Well No.	Location	well depth (m)	SWL /1984 mbgl	Avg. SWL/2000 mbgl	Avg. SWl/2005 mbgl
1.	BB1	Bansbari	238.5	48.08	74.86	82.50
2.	BB6a	Gongabu	200	2.05	20.99	29.27
3.	DK1	Mahankal	72	29.4	29.83	31.85
4.	DK2	Kapan	38.07	+0.4	NA	0
5	DK8	Kapan	34	3.2	2.53	3.35
6.	MH6a	Mulpani	NA		0.97	1.40
7.	GK2a	Nayapati	149	6.13	13.38	23.73
8.	GK5	Nayapati	164	20.16	24.95	20.33
9.	GK4	Nayapati	248	11.25	16.98	16.57
10	BHK1	Bhaktapur	NA		38.07	45.21
11.	M-5	Duwakot,BH	200		92.5	95.23
12.	M-8	Phutung	103		12.7	14.7
13.	M10	Kapan	104		34.11	30.35
14.	M11	Danchi	125		16.42	14.71
15.	M12	Mulpani	308	17.5	33.1	35.24
16.	M13	Mulpani	NA		33.3	36.3
17.	M14	Mulpani	NA		31.8	34.14

18	Bal-1a	Bypass , balaju	149		0.98	8.33
19	G-13	Nepal Rstra Bank, Baluwatar	250		22.81	31.39

5.2 Southern Groundwater District

The southern groundwater district is considered the least potential in terms of groundwater potential (JICA, 1990) due to thick Kalimati clay layer. Also the water quality is considered to be unusable without treatment due to high ammonia and iron. Also comparatively there have been little infrastructural development in this area, the result is there are comparatively few wells in the southern groundwater district. Recently there has been large number of housing and apartments coming up which has increased the number of deep wells in the south.

5.2.1 Surface water sources:

There are two main streams in the south, both are tributaries of River Bagmati. Nakhu River drains the southern parts of the valley flowing from southern hills to the north joining Bagmati near Chovar. In the process, the river irrigates large area in the south and is the only source of water during dry season for the farms in the south. Three main irrigation canals Bhorlekulo, Khokanakulo and Champikulo originates from this river. It is also an important source of water supply for municipal water supply system.

Balkhu River: the second river in the south originates from hills from the south western parts of the valley and drains the entire region of south west and west. The principal source of this river are the numerous spring sources from the hills in the south west. The carbonate rocks from south west produces large nuber of springs which are also an important source of water supply. Major spring sources like Sheshnarayansthan and Saatmul are an important source of water supply for Pharping reservoir which supplies water to Lalitpur District.

5.2.2 Spring sources:

Southern Groundwater District has large number of spring sources mostly located in the south eastern and south western hills. Some of the major spring sources in the area includes:

SheshNrayansthan

Sat mul

Naumul

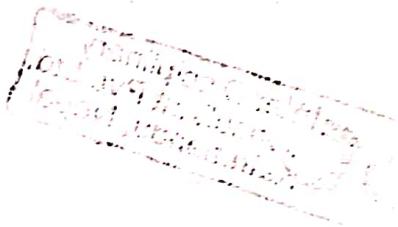
Chalnakhel springs

Simpani

Dudhpokhari

Matatirtha

Godavari springs



Recently these spring sources have become an important source of water supply for tankers ferrying water from spring sources to the valley. Discharge from spring sources in driest month of June reveals the discharge of 73.5 L/s.

The distribution of spring sources and their discharge is as given in the Figure 9.

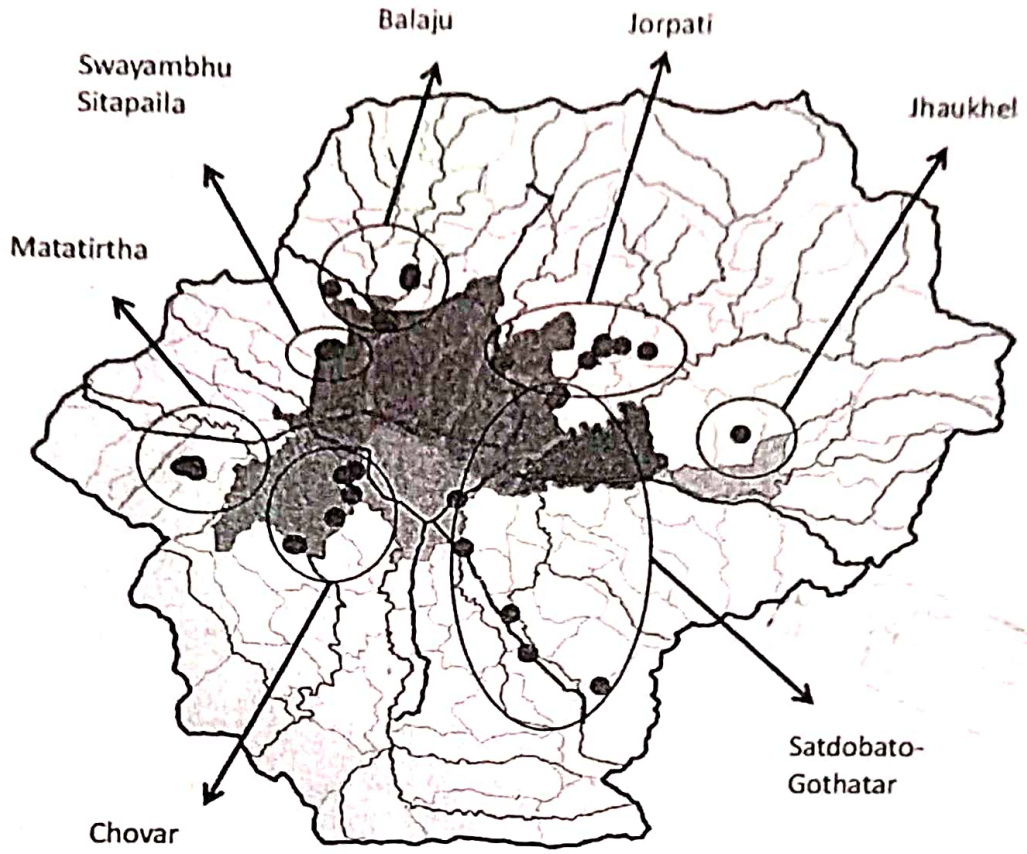


Figure. 9: Location of spring sources and tanker filling stations in Kathmandu Valley (VDWSTA,2013)

5.2.3 Distribution of wells

The current survey has found that the total number of deep wells in the south totals 72 deep wells (Annex II). The distribution of these wells are given in Figure10. Most of the wells are located in the south western part of the valley.

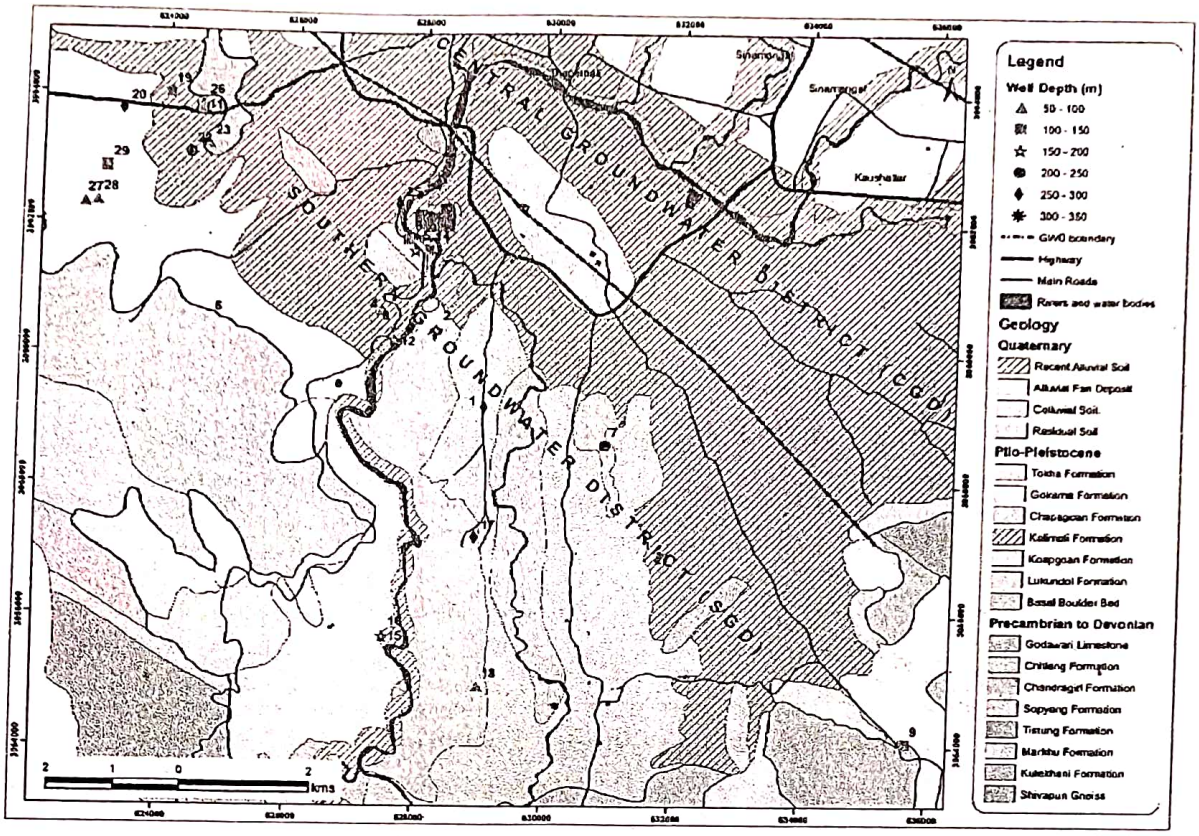


Figure 10: Distribution of deep wells in the Southern Groundwater District

Out of this 72 deep tube wells, 14 deep tube wells belong to KUKL (for drinking purpose), 7 are of MWSDB (for monitoring purpose) and rest belong to other private sectors like industries, academic institutions, hospitals, and government agencies.

The collected data also shows that there is yearly increase in the number of the wells in SGD. In 1988 and 1989 the numbers of the wells constructed were reportedly 3 (in both years) including private sectors.. These data indicate the yearly inclination rate in number of wells in SGD.

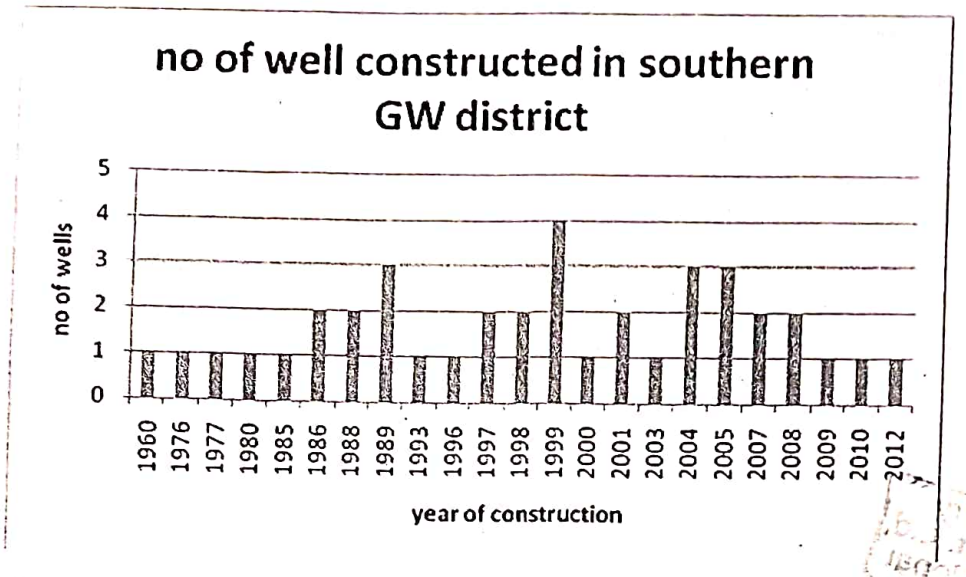


Figure11: No of wells constructed in Southern GW district

Figure11 shows that the numbers of wells constructed in the recent years are very low (only one wells constructed in the year 2009,2010 and 2012). This is in fact quite different from the actual scenario. This indicate that all the data aren't yet been collected and this data gives the misleading interpretation of decreasing number of well construction in recent year.

5.2.4 Depth of the wells

The deep wells range in depth from 60m to 370m. The deepest well is located at at Inter Knit Inudustry at Hatiban. Most of the high depth deep wells are located in the western part. Similarly most of deep wells below 100m are located in estern part of the area. The minimum depth well is kk1 at Khusi-Khusi Resort, Matatirtha Kathmandu with the depth of 60m.

5.2.5 Screens thickness and Static water level

The screens placed in wells range from single screen to multiple screens from single thick screen to 7 numbers of screens. Information on wells screens are available for only 42 deep wells. The screen length ranges from 10m (well 1) to 101m (well PH1a) at Pharping well. Both wells are single screened wells.

Though depth wise the wells are deep wells, some wells have screens below 50m, One well of KUKL at Tyanglaphat has screen at 27m bgl. The maximum depth of the screen lies at the depth of 370m at Interknit Industry at Harisiddhi.

6 wells are monitored for static water level from year 2000-2005 (Annex 2),two of the wells in Pharping and Kirtipur are free flowing wells. The present study has shown that 9 wells are in free flowing conditions at present. Static water level ranges from +5.88m in an observation wells (JW3) in Kirtipur to 85m bgl in Valley Homes in Sunakothi and Sashtrapraharitalim Kendra in matatirtha (Annex II).

There are 9 wells utilizing both the shallow and deep aquifer in the study area(Annex III)

5.2.6 Pumping water level

25 deep tubewells in the southern groundwater district have data on pumping water level. Wells KV103, ksk, kv104 and JW3 belong to KUKL. Pumping water level for individual wells are shown in Annex II. The pumping water level (dynamic water level) ranges from 6.45m to 95m.

Well Discharge: well at Civil Homesin Dhapakhel has the highest discharge of 50 L/s, similarly well at Nirvana Vanasapti at satungal has the lowest discharge of 0.8 L/s. No definite pattern observed in well discharge in the study area.

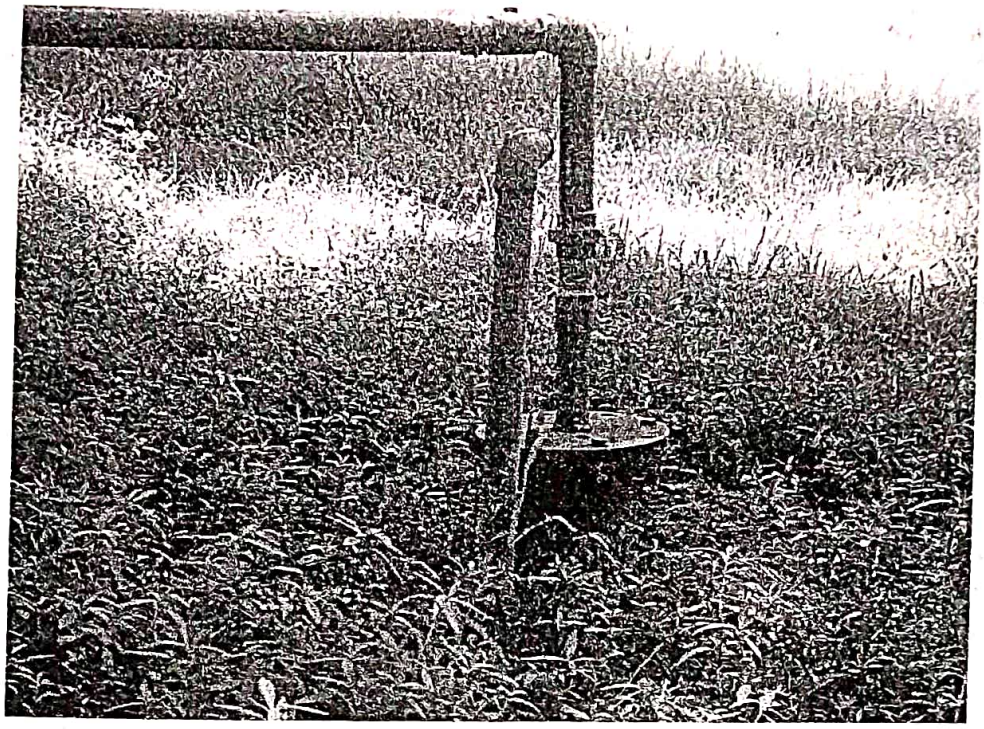


Plate. 2: Groundwater extraction in Southern Groundwater District by KUKL

5.2.7 Monitoring wells

The monitoring data show monthly water level fluctuations in deep wells. The monitoring data of M-1 of Taudaha shows slow decline then steady water level, M2 at Sunakothi shows the increased water level whereas the M3 at Lubhu shows the decline of static water level(swl). Thus there is not much change in the water level in the southern district till 2005(Table 10)

Table 10: Average yearly water table in the monitoring well of SGD

S.No.	Well no	Location	Well depth (m)	SWL in Drilled yr mbgl	Avg. SWL/1999	SWL/ 2000 mbgl	SWl/ 2005 mbgl
1.	G-2	Horticulture farm,Kirtipur	300	00		FF	FF
2.	M-1	Taudaha, Kirtipur	171	/5.42		7.97	7.94
3.	M-2	Sunakothi	230	29.02		28.11	19.70
4.	M-4	Lubhu	225	30.21		30.11	32.05
5.	Ph-1	Pharping	178		4.32	9.53	FF

5.3 Groundwater Policy for Kathmandu Valley, 2011

Recently the government has introduced groundwater policy for Kathmandu valley, under which any groundwater abstraction requires the implementation of Rainwater Harvesting (RWH) system fulfillment. Drilling records of the wells are not properly maintained and thus most of the records of the past wells have been lost. Under the new policy, any groundwater drilling requires license prior to drilling and the owner needs to submit periodic data on static water level, pumping hours etc.

Chapter 6

SUMMARY OF FINDINGS

1. In total database on 253 deep wells have been listed in Northern Groundwater District and 72 in the southern Groundwater district.
2. 98 KUKL extraction wells as well as observation wells are located in Northern groundwater District and 22 are located in the southern Groundwater District.
3. Due to recent trend of housing and apartment constructions, deep wells have increased dramatically in recent years both in northern and southern groundwater districts. 9 deep wells belong to housing colonies in the south. Only 5 are reported from the north, hence the number of deep wells should be much higher.
4. Artesian condition still prevail in various parts of the valley including in Panipokhari,
5. Most of the screens placed at shallow depth in deep wells were constructed before 2000. However many wells constructed recently in Southern Groundwater District have screens at shallow depth.
6. Spring sources are an important source in Southern Groundwater District especially the south western part.
7. Piezometric monitoring data reveal seasonal fluctuation which is against the fossil water theory.

8.

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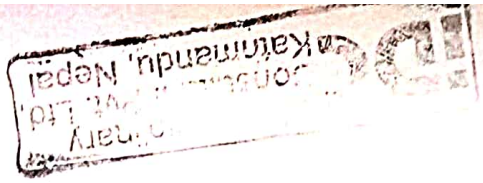
ANNEX I

In CD



129	KUKL (formelry NWSC)	Bansbari, Ktm	BB R5			/2063	Drinking		262	250mm												34.50	55.76	21.00	21.26	
130	KUKL (formelry NWSC)	Bansbari, Ktm	BB1a	632603	3070341	Jan-83	Drinking	1,361.30	239		1298.3-127	1243.3-123	1232.3-122	1210.3-120	1194.3-118	1177.3-117	1139.3-1128.3					48.08	67.60	34.25	19.52	
131	KUKL (formelry NWSC)	Bansbari, Ktm	BB1b	632607	3070334	Jan-97	Drinking	1,361.30	242	250mm	1280.3-127	1238.3-123	1234.3-120	1192.3-117	1173.3-116	1152.3-113	1125.3-1119.3					80.63	136.14	12.00	55.51	
132	KUKL (formelry NWSC)	Bansbari, Ktm	JW2	632613	3070340	1989	Drinking	1,361.80	230	100mm	1239.8-122	1191.8-118	1179.8-116	1140.8-1137.8							74.66	82.50	77.50	79.70	1.83	2.20	
133	KUKL (formelry NWSC)	Basbari,Dhapasi, Ktm	BB0	632065	3070581	Jan-72	Drinking	1,330.90	239	300mm	1267.9-124	1212.9-120	1201.9-119	1210.8-120	1164.8-118	1177.8-117	1139.8-1128.8					42.84	50.65	19.64	7.81	
134	KUKL (formelry NWSC)	Kapan VDC-1,ktm	DK2	633804	3067731	Jan-83	Drinking	1,335.40	62	300mm											0.11	-	29.58	32.58	27.89	3.00	
135	KUKL (formelry NWSC)	Kapan VDC-3, Ktm	DK9	634209	3068307	Jan-84	Drinking		54	300mm													3.50	20.35	5.00	16.85	
136	KUKL (formelry NWSC)	Dhobikhola, Ktm	DK3a	634772	3068681	Jan-84	Drinking	1,329.40	188	300mm	1307.4-129	1204.4-118	1169.4-115	1152.4-1147.4									1.07	20.81	28.55	19.74	
137	KUKL (formelry NWSC)	Dhobikhola, Ktm	DK3b	634781	3068667	Jan-98	Drinking	1,330.10	338	250mm	1209.1-118	1173.1-116	1153.1-114	1115.1-1098.1									33.50	51.00	20.00	17.00	
138	KUKL (formelry NWSC)	Dhobikhola, Ktm	DK4b	634648	3068367	Jan-98	Drinking	1,331.50	163	250mm	1218.5-1172.5												5.80	12.05	44.55	6.25	
139	KUKL (formelry NWSC)	Maharajchaur, Ktm	DK7	633946	3067989	Jan-84	Drinking	1,334.80	55	300mm	1299.8-1288.8												30.09	30.42	9.73	0.33	
140	KUKL (formelry NWSC)	Chalbng, Bansbari, Bkt	BH-BB1	644032	3064265	Jan-97	Drinking	1,363.30	240	200mm	1282.3	1244.3-122	1162.3-1132.3										38.75				
141	KUKL (formelry NWSC)	Chapalgaon, Budhanil	BB9	633601	3072622	Jan-98	Drinking	1,380.40	146	250mm	1374.4-128	1278.4-125	1248.4-1238.4												14.92		
142	KUKL (formelry NWSC)	Gaffutar, Ktm	BB2	632888	3070963	1997		1349.6	190	250mm													31.95	64.35	20.46	32.40	
143	KUKL (formelry NWSC)	Gaffutar, Ktm	BB2			2007	Drinking	1,349.60	300	10"													18.13	32.91	20.07		110.00
144	KUKL (formelry NWSC)	Gongabu, Ktm	BB R3			/2063	Drinking		260	250mm													39.00	42.00	20.00	3.00	
145	KUKL (formelry NWSC)	Balaju, Bypass, Ktm	BAL1a	629052	3069237	Jan-76	Drinking	1,294.00	140	250mm	1215-1208	1194-1155									0.98	8.33					
146	KUKL (formelry NWSC)	Balaju, Bypass, Ktm	BAL1b	630077	3069112	Jan-98	Drinking	1,296.30	158	250mm	1212.3-120	1192.3-118	1186.3-115	1154.3-1139.3									15.55	39.85	22.74	24.30	
147	KUKL (formelry NWSC)	Nayapati-3, Ktm	gk5	638494	3070029	Jan-85	Drinking	1,350.50	106	300mm	1314.5-130	1303.5-129	1297.5-127	1270.5-126	1261.5-1250.5												
148	KUKL (formelry NWSC)	Nayapati-4, Ktm	GK1	639407	3070701	Jan-85	Drinking	1,353.00	269	300mm	1303-1292	1272-1249	1244-1233	1223-1216	1205-1200	1183-1167	1141-1134	1128-1101					8.60	21.17	35.77	12.57	
149	KUKL (formelry NWSC)	Nayapati-4, Ktm	GK4	638776	3070183	Jan-85	Drinking	1,341.00	249	250mm	1295-1244	1234-1223	1189-1183	1167-1156	1135-1100	1100-1094					16.98	16.57	11.25	44.38	29.24	33.13	
150	KUKL (formelry NWSC)	Nayapati-6, Ktm	GK2a	639083	3070297	Jan-85	Drinking	1,341.80	149	300mm	1309.8-130	1300.8-128	1283.8-127	1275.8-126	1265.8-124	1248.8-1203.8					13.38	23.73	6.13	27.29	28.55	21.16	
151	KUKL (formelry NWSC)	Nayapati-6, Ktm	GK2b	639080	3070292	Jan-98	Drinking	1,341.60	199	250mm	1290.6-128	1284.6-127	1272.6-125	1245.6-123	1231.6-120	1204.6-120	1187.6-116	1155.6-1149.6					22.20	33.90	22.45	17.70	
152	KUKL (formelry NWSC)	Nayapati-6, Ktm	GK3	639186	3070175	Jul-84	Drinking	1,346.13	251		13091.13-13	1298.13-12	1276.13-1100.13										10.30	30.85	20.82	29.85	
153	KUKL (formelry NWSC)	Nayapati-6, Ktm	GK3	630788	3068453		Drinking	1,346.13	199	100mm	1208.13-11	1112.13-1106.13											37.84	42.84	8.47	5.00	
154	KUKL (formelry NWSC)	Mahadev Khola, Balaju	MK1	628719	3069781	Jan-96	Drinking	1,303.00	198		1197-1194	1183-1180	1174-1170	1165-1143	1139-1133								15.00	42.00	16.00		
155	KUKL (formelry NWSC)	Mahadev Khola, Balaju	MK2	629444	3070115	Jan-99	Drinking	1,354.10	250	250mm	1268.1-124	1229.1-1208.1													24.96		
156	KUKL (formelry NWSC)	Mahadev Khola, Hiled	MK3	628393	3070306	Jan-98	Drinking	1,301.20	224	250mm	1202.2-119	1172.2-116	1155.2-112	1116.2-1095	1089.2-1086.2										24.99		
157	KUKL (formelry NWSC)	Gongabu, Ktm	BB6a	630895	3070559	Jan-84	Drinking	1,310.60	196	300mm	1277.6-127	1255.6-125	1225.6-120	1165.6-1114.6							20.99	29.27	2.05	19.10	43.67	17.05	
158	KUKL (formelry NWSC)	Gongabu, Ktm	BB6b	630778	3070510	Jan-97	Drinking	1,310.60	206	250mm	1226.6-120	1193.6-119	1181.6-117	1165.6-115	1150.6-114	1138.6-113	1129.6-1108.6						17.53	23.16	25.04	5.63	
159	KUKL (formelry NWSC)	Dhapasi, Ktm	BB R3			/2063	Drinking		250														39.00	42.00	20.00	9.00	
160	KUKL (formelry NWSC)	Gongabu, Ktm	BB7	630396	3069613	Jan-85	Drinking	1,308.20	253	250mm	1223.2-111	1097.2-109	1085.2-1058.2										2.20	6.12	46.32	3.92	
161	KUKL (formelry NWSC)	Gongabu, Ktm	BB8	630417	3069835	Jan-85	Drinking	1,312.20	206	250mm	1220.2-120	1180.2-117	1164.2-1112.2										6.08	12.58	40.58	6.48	
162	KUKL (formelry NWSC)	Gongabu, Ktm	BB3	631156	3071464	Jan-84	Drinking	1,315.30	101	300mm	1291.3-128	1276.3-126	1264.3-125	1242.3-123	1238.3-1220.3								1.36	14.88	43.24	13.52	
163	KUKL (formelry NWSC)	Gongabu, Ktm	BB4	630878	3070980	Jan-84	Drinking	1,309.10	235	300mm	1289.1-127	1270.1-125	1225.1-121	1215.1-121	1189.1-114	1139.1-113	1121.1-1080.1						0.58	9.64	44.11	9.06	
164	KUKL (formelry NWSC)	Gongabu, Ktm					Drinking		208	10"																	
165	KUKL (formelry NWSC)	Gongabu, Ktm	BB5	630564	3070149	Jan-85	Drinking	1,309.10	250	250mm	1231.1-120	1169.1-115	1148.1-114	1139.1-109	1076.1-1065.1								1.75	9.57	41.00	7.82	
166	KUKL (formelry NWSC)	Gongabu, Ktm	KV164			2001	Drinking	1,309.10	300	10"	1205.1-119	1148.1-113	1128.1-112	1119.1-111	1112.1-110	1104.1-1098.1							46.80	52.73	24.68		182.00
167	KUKL (formelry NWSC)	Gongabu, Residental A	BB AW	630077	3069112	Jan-96	Drinking	1,296.30	198	200mm	1186.3-114	1111.3-1105.3											7.00				
168	KUKL (formelry NWSC)	Gongabu, Residental A	BB AW	634209	3068307	Jan-84	Drinking	1,296.30	250	300mm	1284.3-127	1258.3-1247.3											3.50	20.35	5.00	16.85	
169	KUKL (formelry NWSC)	Maharajgunj, Ktm	KV169			2007	Drinking	1,328.00	250	10"	1200-1188	1176-1158											44.95	69.54	25.30		250.00
170	KUKL	Balkot, Bhaktapur				Dec-05	Drinking		270																		
171	KUKL (formelry NWSC)	Bode	BH2				Drinking	1,341.55	275		1249.55-1231.55																
172	KUKL (formelry NWSC)	Bode, Bkt	BH1	637652	3064512	Jan-84	Drinking	1,337.20	175		1296.2-128	1262.2-125	1245.2-122	1198.2-1169.2									20.73	38.59	31.33	17.86	
173	KUKL (formelry NWSC)	Bode, Bkt	bh2b	637648	3064520	/98	Drinking	1,341.20	218		1315.2-130	1260.2-125	1253.2-124	1242.2-123	1153.2-114	1138.2-1133.2											
174	KUKL (formelry NWSC)	Bode, Bkt	bh2a	637624	3064520	/76	Drinking	1,341.70	207																		
175	KUKL (formelry NWSC)	Bode, Bkt	BH R3			/2063	Drinking	1,319.00	200	250mm	1263-1245	1204-1168	1135-1129										30.00	48.00	25.00	18.00	196.00
176	KUKL (formelry NWSC)	Bode, Bkt	BH R5			/2063	Drinking	1,319.00	252	250mm	1247-1241	1224-1188	1142-1136	1085-1079									26.00	36.00	26.00	10.00	240.00
177	KUKL (formelry NWSC)	Bode, Bkt	BH3a	638206	3064948	Jan-85	Drinking	1,328.10	151	300mm	1275.1-123	1232.1-1226.1											10.16	19.01	43.13	8.85	
178	KUKL (formelry NWSC)	Bode, Bkt	BH4a	638051	3065402	Jan-85	Drinking	1,319.00	161		1274-1268	1267-1262	1256-1222	1199-1164									2.00	10.52	46.31	9.02	
179	KUKL (formelry NWSC)	Bode-3, Bkt	BH3b	638203	3064939	Jan-96	Drinking	1,328.00	153	200mm	1272-1254	1230-1224	1213-1180										25.12				
180	KUKL	Hanuman ghat bhaktapur					Drinking		200																		
181	KUKL (formelry NWSC)	Gobarna,Nayapati-2,	GK5	638494	3070029	Jun-84	Drinking	1,351.00	165	300mm	1309-1286	1273-1254									24.95	20.33	20.16	37.10	20.19	16.94	
182	KUKL (formelry NWSC)	Panipokhari, Ktm	JW1	630788	3068453	Jan-90	Drinking	1,324.71	246	100mm	1186.71-115	1090.71-1084.71									9.53	-					
183	KUKL (formelry NWSC)	Bangur Pasan, Balaju,	KV161			Dec-06	Drinking		251	10"													25.00	31.11	15.00	31.11	97.00
184	KUKL (formelry NWSC)	Sanivatar, Gongabu					Drinking		250																		
185	KUKL (formelry NWSC)	Gokarna, Ktm	KV162			2007	Drinking	1,312.70	250	10"	1260.7-125	1230.7-122	1223.7-122	1196.7-119	1181.7-117	1167.7-1158.7							18.13	32.91	20.07		110.00
186	KUKL (formelry NWSC)	Gokarna, Navanipati, 2	GK-2				Drinking		274																		
187	KUKL (formelry NWSC)	Gokarna, Navanipati, 2	GK-2				Drinking		279																		
188	KUKL (formelry NWSC)	Mulpani, Ktm	MH2	638250	3067116	Jan-84	Drinking	1,334.80	308	250mm	1293.8-128	1273.8-126	1259.8-123	1209.8-120	1196.8-112	1110.8-107	1064.8-104	1039.8-1032.5					17.50	32.40	37.33	14.90	
189	KUKL (formelry NWSC)	Mulpani-2, Ktm	MH5b	637361	3065830	Jan-96	Drinking	1,314.30	194	250mm	1285.3-127	1208.3-120	1194.3-118	1181.3-116	1147.3-114	1138.3-1126.3						1.04	24.97	6.82	24.00	35.00	
190	KUKL (formelry NWSC)	Mulpani-2, Ktm	MH6a	637858	3065837	May-85	Drinking	1,314.30	198	250mm	1292.3-127	1255.3-123	1233.3-122	1216.3-121	1204.3-119	1198.3-116	1144.3-1122.3						1.20	6.07	43.13	4.87	
191	KUKL (formelry NWSC)	Mulpani-4, Ktm	MH4	637639	3066576	Jan-85	Drinking	1,326.90	237	250mm	1306.9-130	1296.9-128	1268.9-126	1254.9-124	1232.9-118	1171.9-116	1157.9-115	1141.9-1092.9					5.15	17.64	39.75	12.49	
192	KUKL (formelry NWSC)	Mulpani-4, Ktm	MH5	637772	3066170	Jan-85	Drinking	1,317.50	202	300mm	1264.5-124	1242.5-120	1201.5-119	1188.5-117	1171.5-115	1143.5-1121.5							1.30	10.27	39.34	9.02	
193	KUKL (formelry NWSC)	Mulpani-5, Ktm	MH3a	637645	3066923	Jan-84	Drinking	1,336.40	323	250mm	1291.4-128	1266.4-124	1229.4-121	1206.4-119	1178.4-116	1162.4-115	1134.4-110	1090.4-1084.4					14.40	29.58	38.14	15.18	
194	KUKL (formelry NWSC)	Mulpani-5, Ktm	MH3b	637838	3066932	Jan-96	Drinking	1,336.50	287	250mm																	

195	KUKL (formelry NWSC)	Ramhiti,Nayabasti,Kag	DK-4			Jan-96	Drinking	1,336.50	287	250mm	1255.5-124	1205.5-116	1173.5-116	1163.5-115	1113.5-110	1063.5-1054.5					14.40				
196	KUKL (formelry NWSC)	tanker section, mahar	DK1	633708	3067757	Jan-84	Drinking	1,331.50	165		1226.5-120	1203.5-1171.5													
197	KUKL (formelry NWSC)	rambiti,Baudha-6, Ktm	DK 3b	634781	3068667		Drinking	1,335.00	92																
198	KUKL (formelry NWSC)	rambiti,Baudha-6, Ktm	DK 4b	634648	3068367		Drinking	/1330.4	240																
199	KUKL (formelry NWSC)	Jadibuti, Bkt	JW4	633804	3062724	Jan-89	Drinking	/1332	165																
200	KUKL (formelry NWSC)	Jadibuti, Bkt	JW4	627772	3064875		Drinking	1,305.20	280	100mm	1105.2-109	1090.2-1078.2									1.90				
201	KUKL (formelry NWSC)	Sundarghat, Ktm	JW3	627758	3062547	Jun-98		1,305.20	260	250mm	1103.2-107	1072.2-1052.2						48.00							
202	KUKL (formelry NWSC)	Shankhepark					Drinking		284	100mm											33.50		20.00	17.00	
203	KUKL (formelry NWSC)	Sallaghari, Bhaktapur	BH2				Drinking		187																
204	KUKL (formelry NWSC) offic	Mahankalchaur, Ktm	dk5	633804	3067731	/83	Drinking	1,335.10	280																
205	KUKL (formelry NWSC) offic	Mahankalchaur, Ktm	DK1	633708	3067757	Jan-84	Drinking	1,335.00	65	300mm	1292.1-1276.1														
206	Om Hospital & Research Cer	Chabahil	OM					1,335.00	72	300mm	1297.7-129	1286.7-1270.7													
207	Pashupati	Gaushala, ktm				/1997		1,317.00	204		1161-1119							29.83	31.85	29.40	14.95	23.93	5.57		
208	Pranesh Sharma	Mandikatar, Ktm							210																
209	Pashupati	Gaushala, Ktm	KV180			1995	Drinking		200	6"															
210	Pataula Garment	Attarkhel, Jorpati				2000	Drinking	1,315.00	225	6"	1126-1090										49.20	52.83	6.95		198.00
211	Pear Carpet Industries	Boudha							170m												35.80	48.80	8.00		632.00
212	PV Array	Bode, Bhaktapur	KV186			Jun-05			50																
213	Rastrapati Bhavan	sital Niwas				1994	Drinking	1,337.20	300	8"	1243.2-123	1228.2-121	1199.2-118	1189.2-110	1058.2-1052.2						62.30	79.60	3.88		364.00
214	Real Estate Drinking Water	Gangabu, Ktm				Nov-10			205																
215	Rokpha International Nepal	Gangabu, Ktm				27/5/2052		1,301.00	145		1209.5-1194	1171.5-116	1166-1160								20.00	30.00			
216	Sagarmatha Drilling Co.	Bode, Bhaktapur	KV195			Jul-03		1,301.00	220												4.00		7.50	17.00	
217	Samye Memorial	Maharajgunj, Ktm	KV198	634771	3069557	Jun-06		1,337.20	252									49.00			26.00		26.00	10.00	
218	Shangrila Carpets	Baudha, Ktm		636583	3067891	1996	Drinking	1,315.30	202	4"	1205.3-1195	1193.3-118	1157.3-1154	1145.3-1142	1135.3-112	1120.3-1114.3					60.0	61.80	2.03		202.00
219	Shangrila Carpets	Besigaon, Jorpati, Ktm		636567	3067901	1996		1,336.40	186																
220	Shyalpa Monastry	Kapan, Ktm	KV203			1997		1,336.40	55																
221	SOS Balgram	Sanothimi, Bkt	p27	635423	3063589	2002	Drinking	1,420.00	60	6"	1408 1360														
222	Srongtsen Bhrikuti Boarding High School	Sanothimi, Bkt				1982		1,331.00	257	150mm	1210-1198	1119-1088	1085-1078								30.85	39.15	0.33		485.00
223	TB Hospital	Sanothimi, Bkt	KV215	636556	3062454	1997		1,313.00	250																
224	Teaching Hospital	Maharajgunj		631393	3069323	/1985		1,330.00	250																
225	Tenzing Carpet	boudha				1984			50																
226	Taragaon Regency	Baudha, Ktm	KV213			1999	Drinking		300	6"															
227	Taragaun Regency Hotel	Bouddha, Ktm	H34	634131	3067910	Oct-95			267	200mm											58.00	85.91	6.67		
228	Tribhuvan Airport	Airport, Ktm	P24			1986	Drinking		85	4"											35.00		2.00	22.00	
229	Tribhuwan Int. Airport	Golf course, Ktm	KV221			Sep-94			225												9.50	14.36	5.00		
230	U. S. Embassy	Panipokhari, Ktm				Jun-05			250												27.60		11.00	33.05	
231	UCEP	Thimi, Bhaktapur	P28			Jul-82		1,331.00	213	150mm	1231-1220	1143-1118									30.00		15.00	5.00	
232	Water Supply	Katunje, Bhaktapur				2002	Drinking	1,335.00	148	6"	1224 1188										3.00				
233	Water Supply & Sanitation	Katunje, Bhaktapur	KV230			Mar-08		1,335.00	140	8"											0.00	18.56	13.33		313.00
234	WHO observation well	Gokarna							130												16.00	29.11	2.00	13.11	339.00
235		Gokarna						1,312.70	150		1281.2-127	1271.2-126	1254.5-124	1247.1-124	1235.79-12	1220.2-1174.4									
236		Gokarna	W5					1,312.70	165	300mm	1276.7-127	1266.7-124	1233.2-122	1223.7-1212.7											
237		Balaju				Jul-89		1,304.80	280		1119.8-111	1104.8-109	1089.8-1077.8												
238		Basbari,Ktm	B2			28/01/65		1,340.00	79																
239		Gaushala near Pashup	B19			Jan-66		1,315.00	115		1231 1211														
240		Maharajgunj, Ktm						1,315.30	294		1134.3-112	1104.3-109	1092.3-108	1074.3-105	1044.3-1038.3										
241		Katunje	B20					1,335.00	160		1263 1177														
242		Katunje, Bhaktapur				/1997		1,335.00	230																
243		Bhaktapur	4					1,331.00	253		1285.9-128	1279.09-12	1268.09-12	1256-1240	1239.9-123	1211-1204	1199.4-1176.2								
244		Bhaktapur	1					1,331.00	280		1290.01-12	1256.01-12	1239.33-12	1192.03-1162.73											
245		Bhaktapur	BH4					1,331.00	170		1277 1261	1252 1211	1205 1177												
246		Bhaktapur	3					1,331.00	260		1277.58-124	1249.08-12	1215.9-1185.4												
247		Bhaktapur	2					1,331.00	260		1293.77-124	1282.77-12	1260.87-1079.9												
248		Bhaktapur	W4					1,331.00	165	300mm	1295 1289.5	1285 1262	1251.5-124	1242 1231											
249		gabgabu	GB3					1,300.00	200																
250		gabgabu	GB1					1,300.00	100																
251		bansbari	B2					1,342.00	77																
252	Ningshing Lumbini j/v	Nepali height Ktm							318	250mm															
253	National Drilling Company p	Mahadevkhola Balaju, ktm							277	250															
254	Raniban Monesstry	Raniban ktm							100																
255	Danida	Lainchaur				1990	Industry		260	4"															
256	hotel Shankar	lazimpat				1991	Drinking		260	6"											19.25	23.33	3.58		321
257	Shakti carpet	Baudha				1993	Industry		285	4"											20.95	38.63	0.58		289
																					29.5	33.5	336.2		129.2

ANNEX II

In CD

SN	Client	Location	Well No.	Co-ordinates		Date of Cons-truction	Purpose	Elevation	Drilling Depth (m)	Diameter of Screen	Screen Section (AMSL)	
				X	Y						11	22
1	CE Constru	Balambu, Ktm				Mar-03		1,345.00	105			
2	District Wat	Thankot, Ktm				Jul-99			300			
3	DSR Knitwa	Satungal, K	KV48			Jan-00			237			
4	Dugad Food	Satungal, Ktm		628420	3068219	1988	Industry	1,308.70	160	4"	1185.7 ~11	1158.7-1149.7
5	DWSS	Naikap, Ktm		624505	3063773	/1985		1,331.00	122			
6	Himal Cem	Chobhar, Ktm		627580	3060261	1986	Industry	1,269.00	156	6"	1150 ~ 1120	
7	Himal Cem	Chobhar, ktm		627574	306253	/1986		1,269.00	156			
8	Indian Sch	Chobhar, K	KV87	628081.382	3061661.2	2001	Drinking	1,269.00	130	4"	1207 ~ 116	1181 ~ 116
9	KUKL (form	Pharping, K	PH1a	627490	3055707	Jan-76		1,253.70	178	250mm	1182.7 ~1080.7	
10	KUKL (form	Pharping, K	PH1bC					1,253.70	185		1179.3 ~1096.7	
11	KUKL (form	pharping,kt	ph-1	627490	3055707			1,254.20	175			
12	KUKL (form	Bungmati,la	ph3	628892	3057249	Jan-98		1,351.30	270			
13	KUKL (form	Bungmati-9	PH2	628993	3054932	Jan-77		1,248.90	90	250mm	1211.9 ~11	1183.9 ~1164.9
14	Makalu Trav	naikap, Ktm				/1999			300			
15	Melamchi w	balambu	mb					1,350.00	148			
16	MWSDB	Balambu Sc	M 7	624000	3064000		Monitoring	1,358.80	147			
17	Nirvan Vana	Satungal, Ktm		623298	3063744	1988			280	4"		
18	Sipradi Trad	Naikab, Ktm		626321	3064344	1996		1,288.30	259			
19	Sagarmatha	Naikab, Ktm	KV205			1999	Industry	1,288.30	177	4"	1201.3 ~ 11	1183.3 ~11
20		Chobhar North						1,316.00	324			
21	Gokul Abas	Bhaisepati, Saibu		85	28	2069 B.S		1,332.00	265		1230 ~ 122	1062 ~ 1038
22	Vinayak Co	Bhaisepati, Saibu		85	28	2066 B.S		1,304.00	170			
23	NK Water S	Chobar		85	28			1,270.00	125		1260 ~ 1206	
24	Chakrathali	Chobar		85	28			1,264.00	85		1227 ~ 1179	
25	Modern Ind	Chobar		85	28			1,278.00	200			
26	KUKL	Kirtipur ,Sim	kks	85	28			1,333.00				
27	Civil Homes	Dhapakhel		85	28	2067 B.S		1,369.00	220		1324 ~ 131	1305 ~ 130
28	Shrijana Pu	Chobar		85	28	2065 B.S						
29	Himalayan	Godawari		85	28			1,490.00	150			
30	KUKL	Bhaisepati	kbp	85	28			1,335.00				
31	KUKL	Changathali	kcg	85.22041	27.39443			1,310.00				
32	Drinking wa	Tinthana-1		624344	3063098		Drinking	1,338.00	212			
33		Bishnu devi temple, Tintha		624628	3063223			1,339.00	100			
34	MWSDB	Taudaha	M1	627000	3061000		Monitoring	1,300.00	171			
35	Horticulture	Kirtipur	G2	627605	3062361			1,328.00	300		1248 ~ 123	1199 ~ 118
36	MWSDB	Lubhu VDC	M4	636000	3059000			1,372.40	225		1208.4 ~ 11	1185.4 ~ 1147
37	Asian Drillin	Old Naikap		624503	3063826			1,338.00	200	200mm		
38	Amrawati C	Matatirtha, Kathmandu		622770	3062284			1,443.00	80			
39	Khusi-Khus	Matatirtha,	kk1	622957	3062308			1,427.00	60			
40	Dhaulagiri H	Satungal, Ktm		623085	3062846			1,395.00	108			
41	Mountain A	Bhaisepati, Saibu							200	6"		
42	Sasastra pr	Matatirtha,	s1						135	150mm		
43	asian drilling	jalbinayak, kirtipur-14, Lalitpur							80	150mm		
44	GEOCE gro	Dhapakhel, Kathmandu							202			
45	syuchatar w	syuchatar, ktm							120	200mm		
46	KVWSNV,	Hattiban, lalitpur							200	6"		
47	civil Homes	sunakothi, lalitpur							233			
48	Central Horticultur e Center	Kirtipur	p31b	627621	3062365	1980		1,275.00	300			
49	Central Horticultur e Center	Kirtipur	p31	627605	3062361	/1997		1,275.00	300	150	1145-1139	1073-1067
50	Civil Homes	Tin Thana				Apr-60			82			
51	Higher Edu	TU, Kirtipur, Kathmandu				Nov-98		1,328.00	300	200x100mm	1172-1154	1126-1114
52	Horticulture	Kirtipur, Ktm	g2	627605	3062361	1997	Gardening	1,275.00	300	6"	1145-1139	1073-1067
53	Internationa	Hattiban, Lalitpur				Oct,1993		1,320.00	282		1270-1234	
54	JICA (JW-3	kirtipur Ktm				1989	observation	1,361.30	284	4"	1127.3-111	1109.3-110
55	JICA (JW-4	Kirtipur	KV90			1989		1,275.00	230	4"	1075-1063	1060-1048
56	KUKL	Tyanglapha	KV103			2008	Drinking	1,328.00	110	6"	1301-1295	1285-1259
57	KUKL (form	kalanki	kl1	626394	3064252			1,286.20	214			
58	KUKL (form	Shiuchatar,	ksk			2007	Drinking		250	6"		
59	KUKL (form	Shiuchatar,	KV238			2061			105			
60	Melamchi w	kalanki	mk					1,318.00	202			
61	Nepal Elect	Suichatar, K	KV152			Jul-99			250	200x150mm		
62	Raybot Spri	Chalnakhel,	KV190			Jan-01			121			
63	Tribhuvan U	Kirtipur		626606	3062945			1,335.00	300	150mm	1179-1161	1133-1121
64	Bright Horiz	Matathirtha,	kv21			May-04			63			
65	Children We	Matathirtha,	kv30						69			
66	dipak khana	thankot, ktm	KV45			Jan-07			150	6"		
67	Interknit Ind	Hattiban, La	P37			Jun-05	industry		370	6"		
68	KUKL	Jhotungepu	kv104			Jun-05	drinking		280	10"		
69	MWSDB	Sunakothi-1	m2	630000	3058000		Monitoring		230			
70	MWSDB	Near LRI Sc	M6	625500	3062000		Monitoring					
71	NWSC	Sundarigha	JW3	627758	3062547	Jan-89			284	100mm		
72	Shrestha C	Hansiddi, la	KV202			Jun-05	Industry		70	6"		
73	MWSDB	ambu School,	M 7	624000	3064000		Monitoring		147			
74	Valley Homes	unakothi, Lalitp	KV226			2004	Drinking		306	4"		

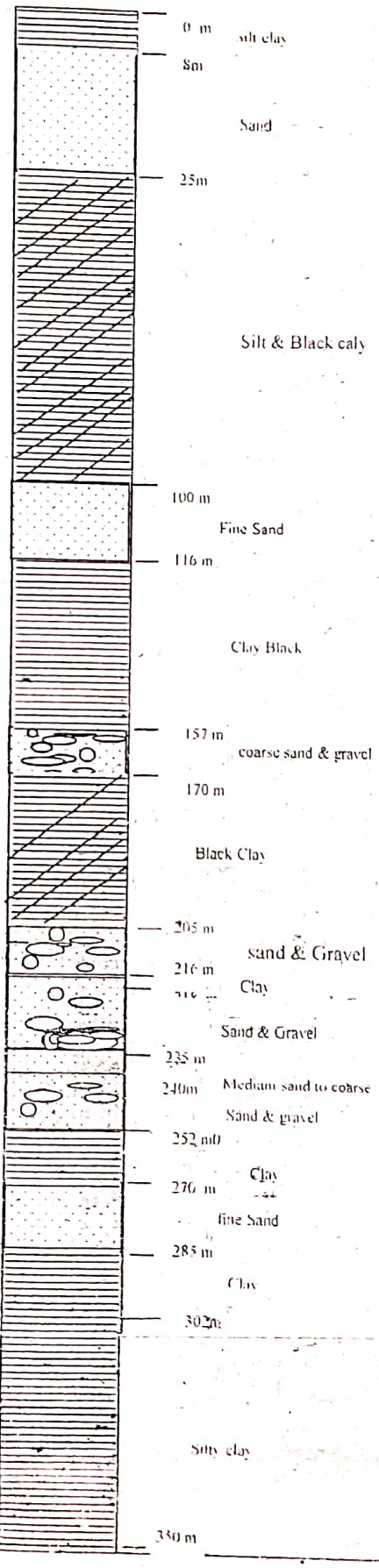
22	33	44	55	66	77	Number of screen	Screen Thick-ness (m)	Water level in 2000(m)	Water level in 2005(m)	Static Water Level (m)	Dynamic Water Level (m)	Pump-ing Rate (l/s)	Draw-down (m)	EC (µS/cm)
						3				8.00		4.00	11.00	
										32.00		3.00	16.30	
-1149.7						2				1.78	57.14	1.83		
						1				+0.0	21.95	2.17		
						3				7.00	27.52	11.67		865.00
116	1157 ~ 1139					1		-	-					
						1								
						1								
						2				3.00				
~1164.9														
						2				5.18				
						1		-	-	Artesian				
										0.0	66.0	0.80		
~11	1153.3 ~ 11	1129.3 ~1117.3				4				+ 1.5	40.0	5.00		510.00
						3								
1038						2				-	-	-		
						1				30.00	52.00	166.66		
						1				1.50	15.00	366.66		
130	1199 ~ 1178					3				41.70	65.20	50.00		
														-
118	1112 ~ 110	1304 ~ 107	1074 ~ 1073			7								
~ 1147.9						2								
						1				4.00	85.00	1.5 l/s	35.00	
						1								
						1				85.00	95.00	3 l/sec	3.00	
						1				28.00	35.00	6 l/sec	18.00	
						2								
						2				26.00				
						2								
										25.63	68.79	2-4l/s		
067	1058-1055	1035-1032	1026-1023	1013-1003		6.00								
						2.00				24.50	49.00	4-Jan		
114	1058-1034					3.00				30.00		2.00	12.00	
067	1058-1055	1035-1032	1026-1023	1013-983		6.00	-	-		0.00	52.68	2.50		485.00
						1.00				12.90	35.75			196.10
110	1093.3-1081.3					3.00				+ 5.88	47.15			428.00
048						2.00				1.90	6.45	10.19		870.00
259						2.00				14.60	32.45	4.08		130.00
						3.00				23.27	51.39	5.00		350.00
						5.00								
						4.00								
						4.00				33.00		8.00	21.10	
										Artesian		4.00		
121	1065-1041					3.00								
										4.00		2.00	7.00	
							42.00			Artesian	40.80	5.00		
						4.00				22.50	43.51	2.38		
						5.00				18.10	20.74	24.68		580.00
										29.02				
										Artesian				
						3.00				15.88	50.88	1.67	45.00	
						2.00				36.0	51.0	0.96		482.00
							0.00	0.00	Artesian					
									25.80	65.00	1.33		220.00	

ANNEX III

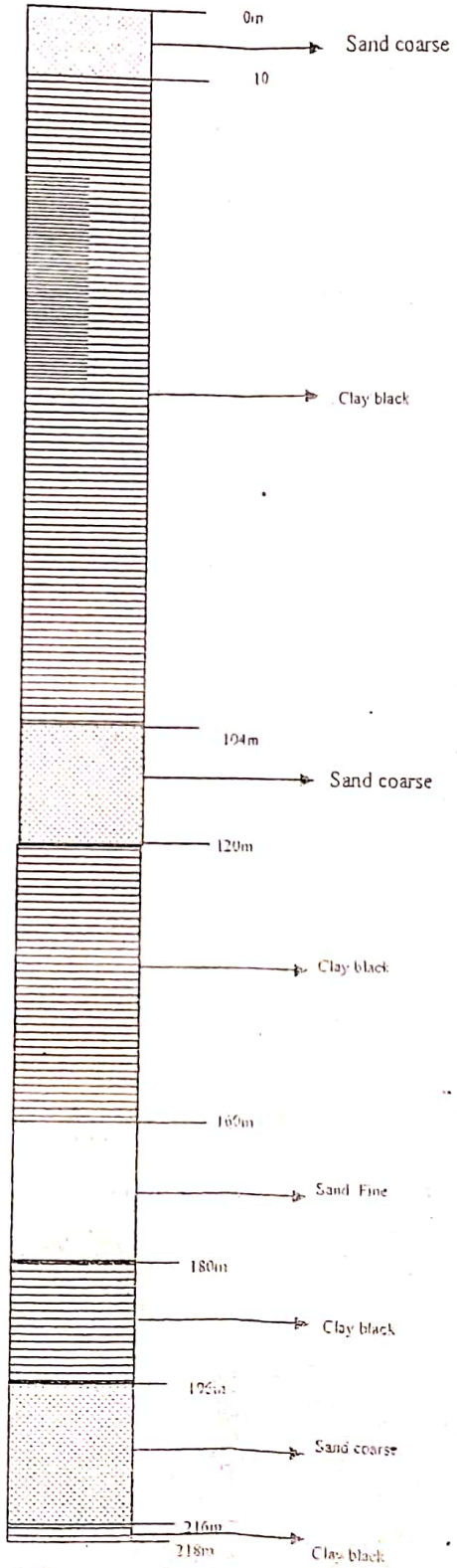
NATIONAL INSURENCE BULDING

LAMA CONSTRUCTION

LITHOLOGICAL LOG

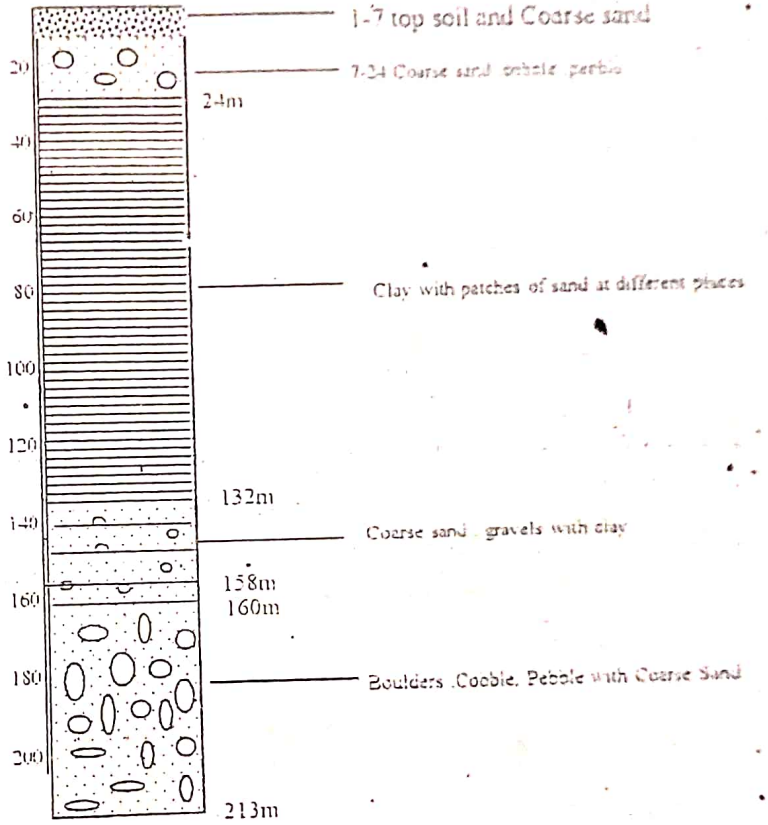


HOTEL MANASLU
LITHOLOGICAL LOG



WATERWELL DRILLING AT JHAUKHEL, BHAKTAPUR

LITHOLOGICAL LOG

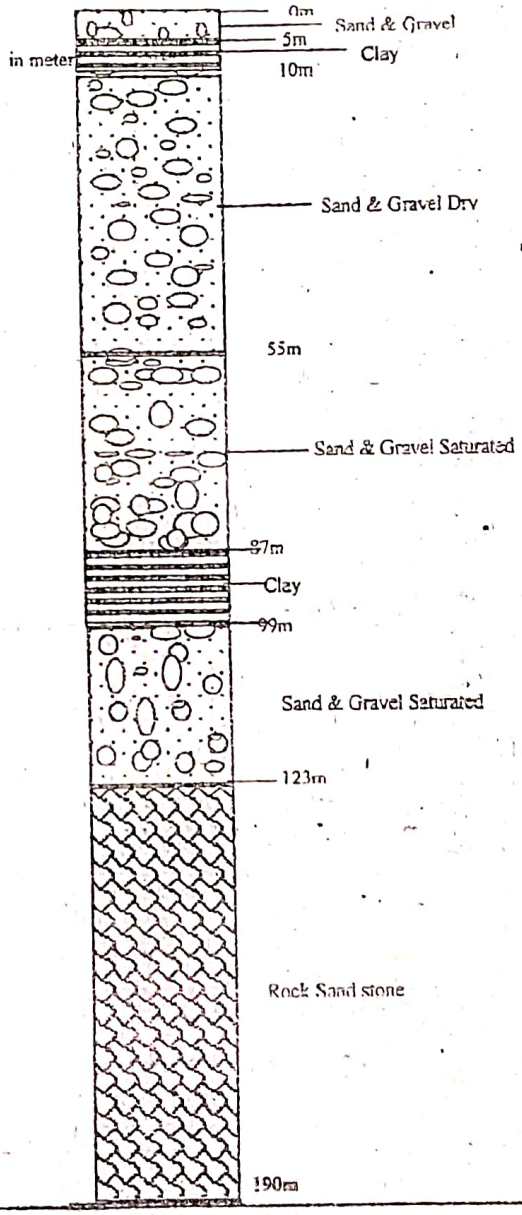


SAGARMATHA DRILLING COMPANY

NEPAL WATER SUPPLY CORPORATION

WATERWELL DRILLING AT Bansbari(Treatment plant BB-R10)

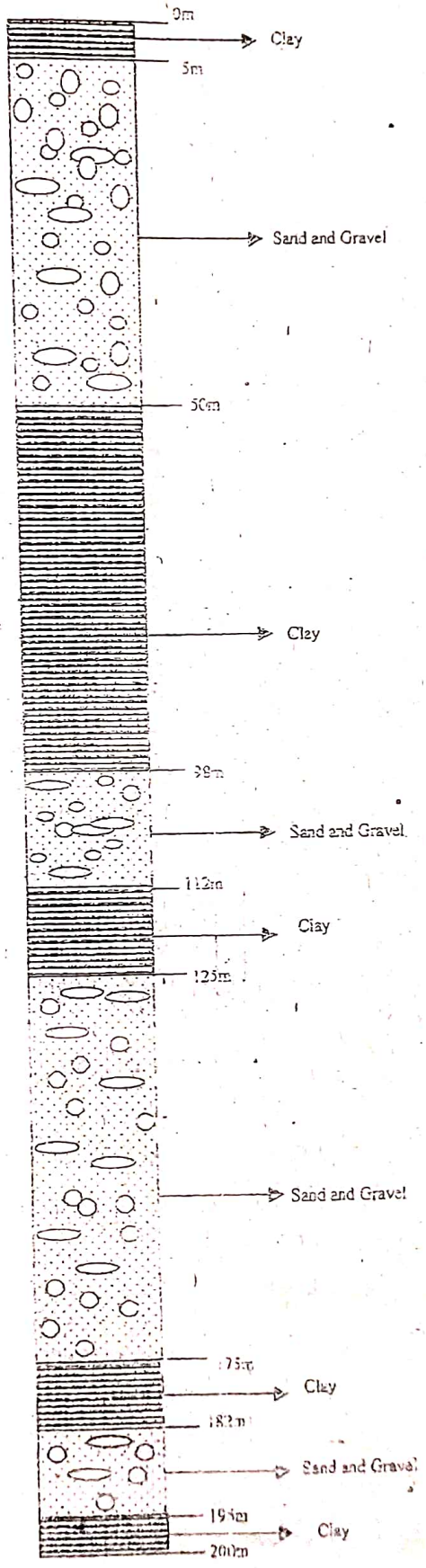
LITHOLOGICAL LOG



BALAJI INVESTMENT PVT LTD.

WATERWELL DRILLING AT PANIPOKHARI ,KATHMANDU

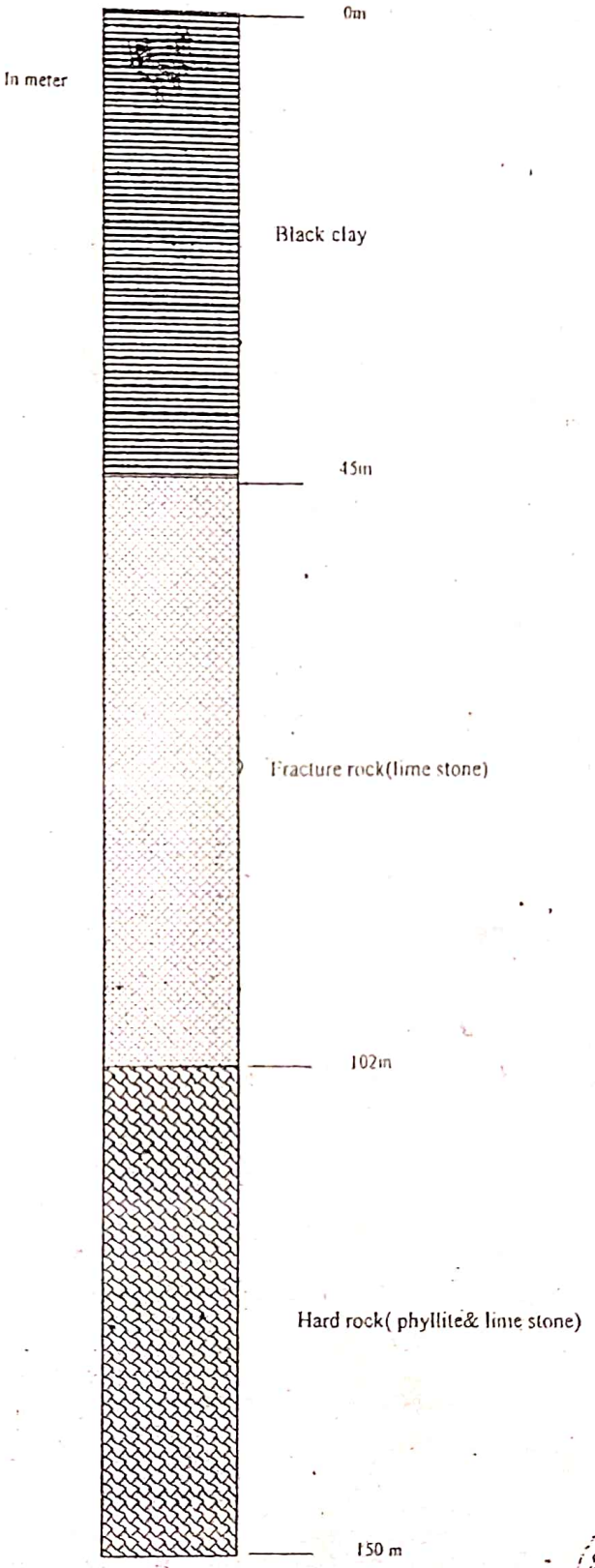
LITHOLOGICAL LOG



ASIAN DRILLING COMPANY PVT LTD.

DRINKING WATER & SANITATION ,BHAKTAPUR

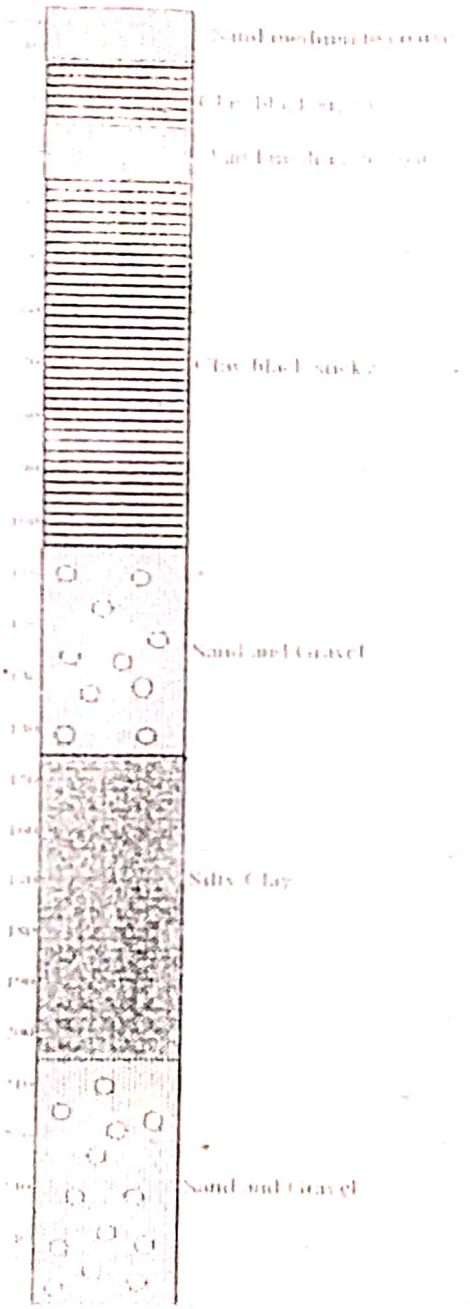
LITHOLOGICAL LOG



Asian Drilling Co. PVT. LTD.
Bhaktapur

NEPAL RASTRA BANK

LITHOLOGICAL LOG

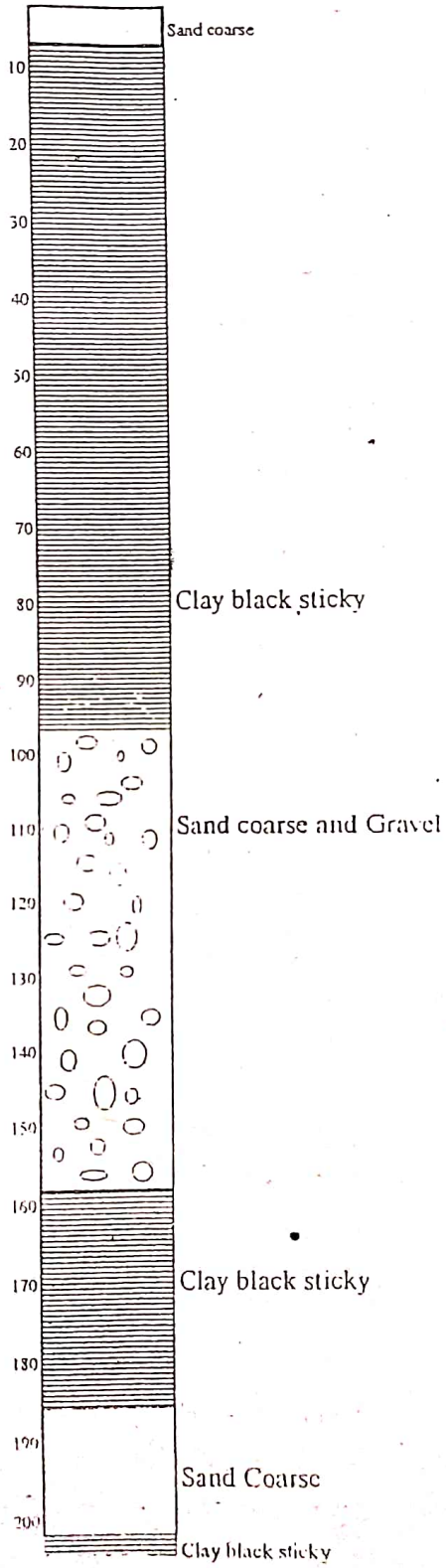


NATIONAL DRILLING COMPANY

NEPAL WATER SUPPLY CORPORATION

WATERWELL DRILLING AT GONGABU

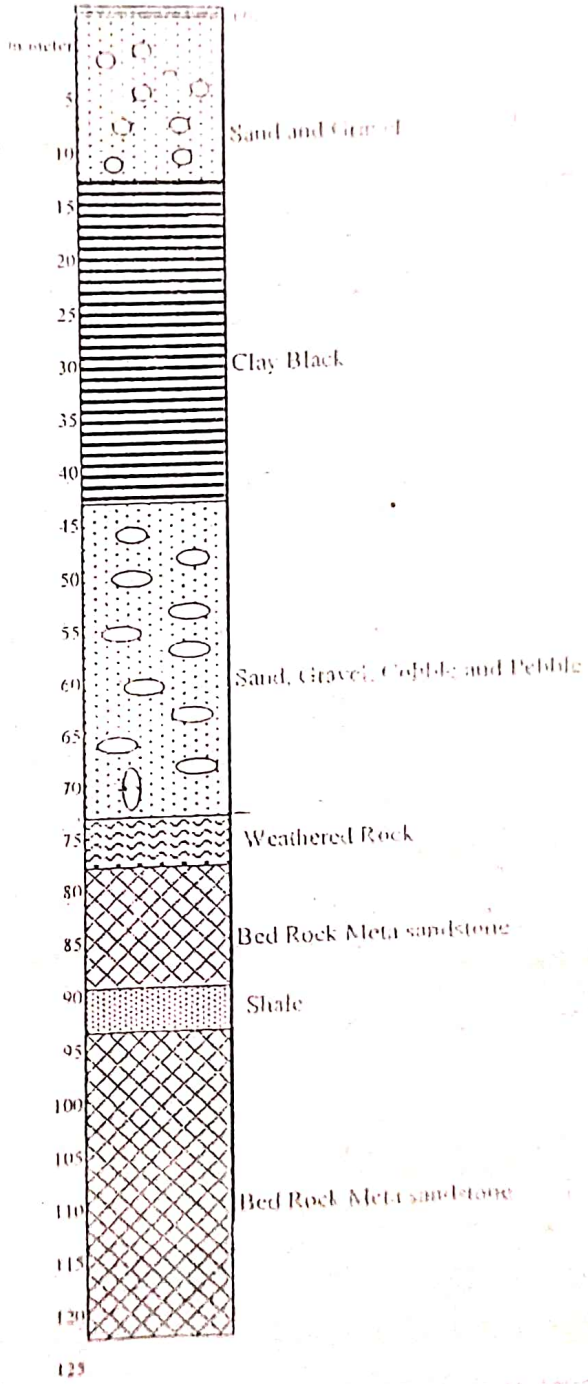
LITHOLOGICAL LOG



BASP (Well No. 2)

WATER WELL DRILLING AT GUIHE [illegible]

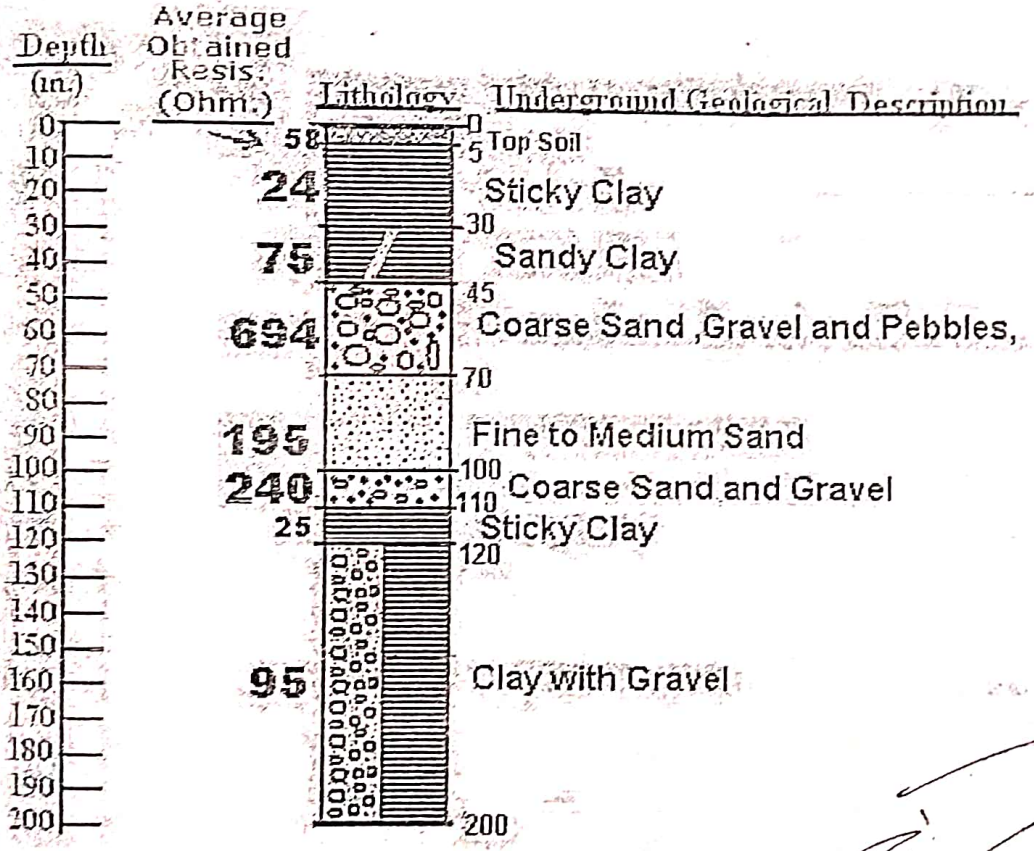
LITHOLOGICAL LOG



LITHOLOGY

Client : **KVWSMB**

Owmer : MORAG AUTO WORKS PVT. LTD. , Hattiban ,Lalitpur-District.



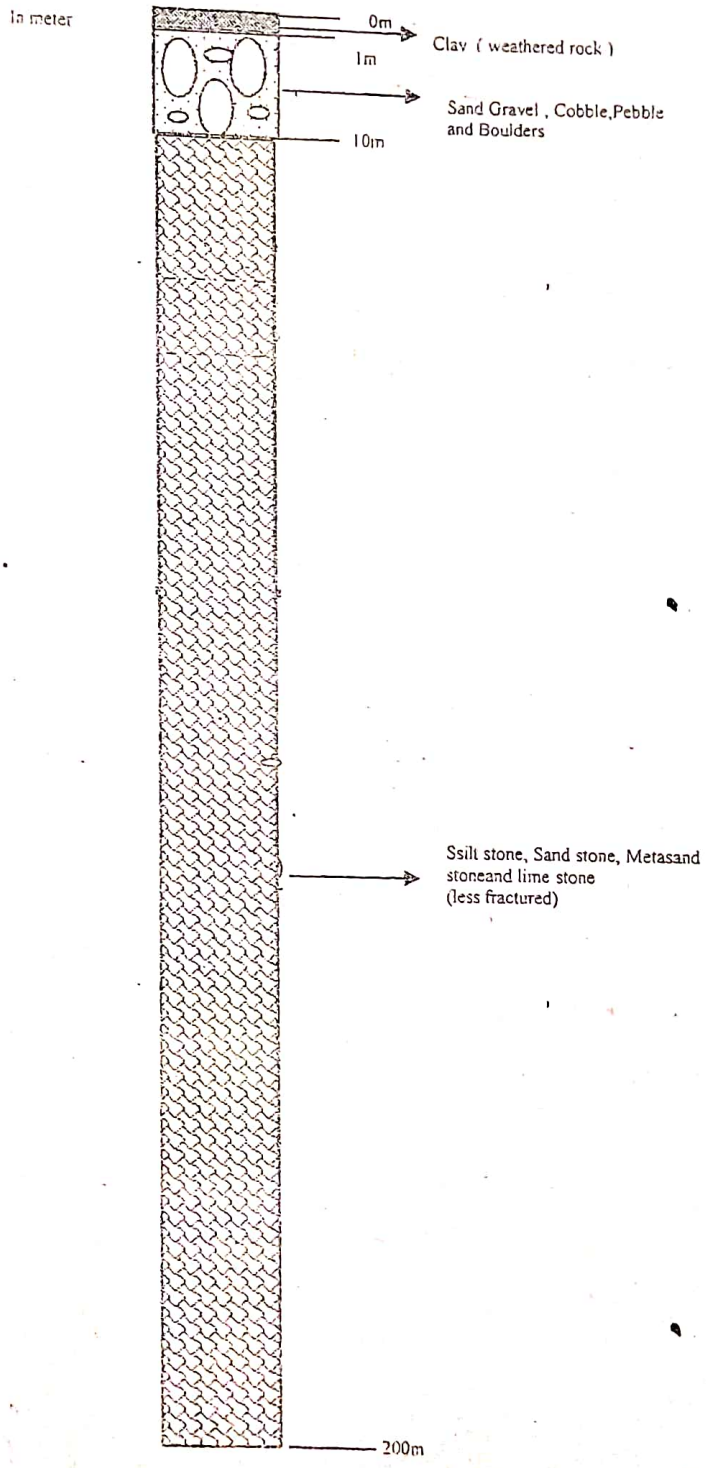
Drawn By

Ram Chandra Pd. Rauniyar
Sr . Geo-Physicist

ASIAN DRILLING COMPANY PVT LTD.

WATERWELL DRILLING AT OLD NAIKAP , KATHMANDU (RWSSM) DWSS

LITHOLOGICAL LOG



ASIAN DRILLING COMPANY PVT LTD.

WATER WELL DRILLING AT JALBINAYAK, KIRTIPUR-14, LALITP

LITHOLOGICAL LOG

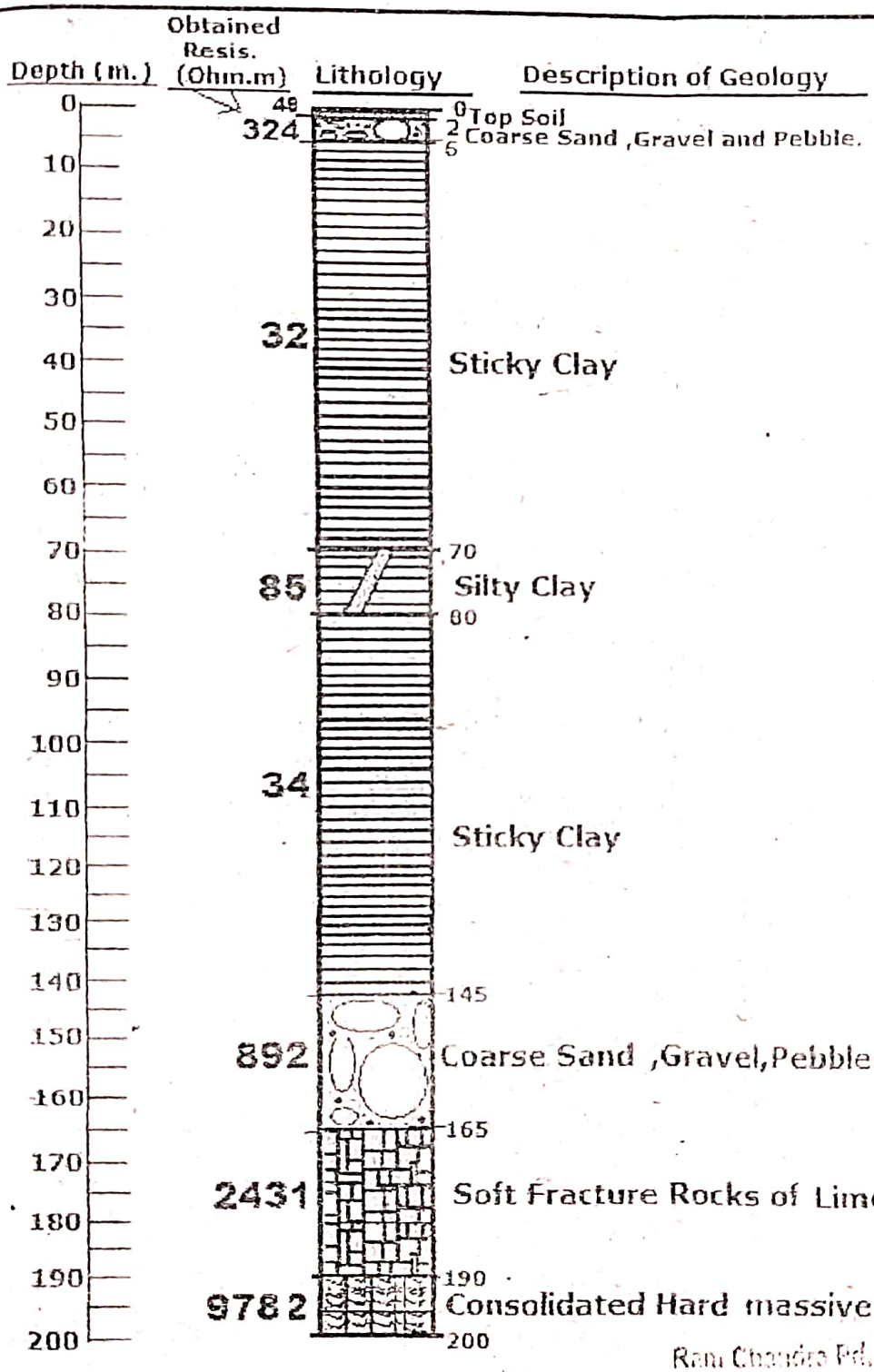
LITHOLOGY

of

Sounding Location

Client : **MOUNTAIN ARTS COMMUNICATIONS PVT. LTD.**

Address : Saibu-6 Kha ,Bhaisepatee, Lalitpur-District,Nepal



Ram Chandra Pd. Raunlyar

Drawn By

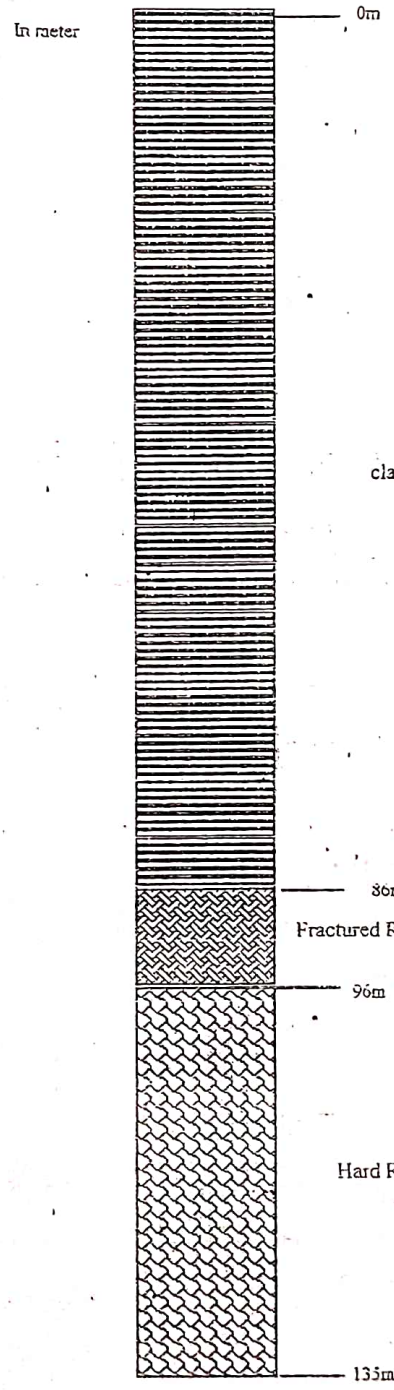
Madan Pd. Lamichhane

Hydro-Geologist

ASIAN DRILLING COMPANY PVT LTD.

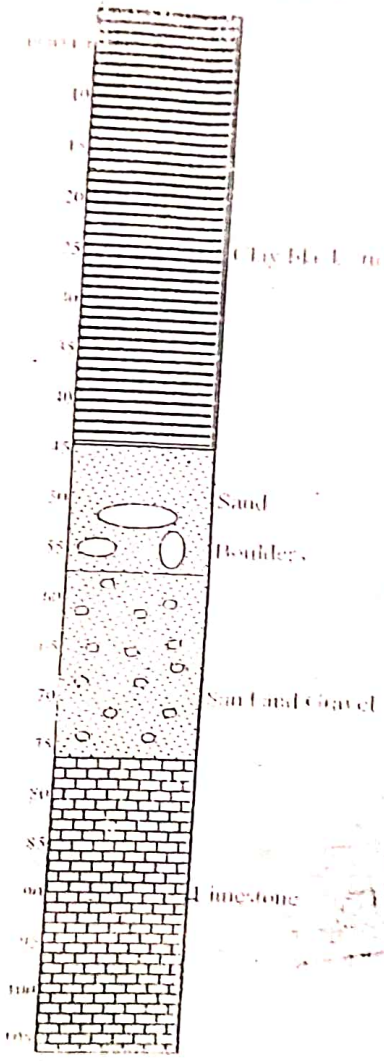
WATERWELL DRILLING ATSASASTRA PRAHARI TRAINING CENTER, MATATIRTHA

LITHOLOGICAL LOG



Asian Drilling Co. (P) Ltd. ADCO

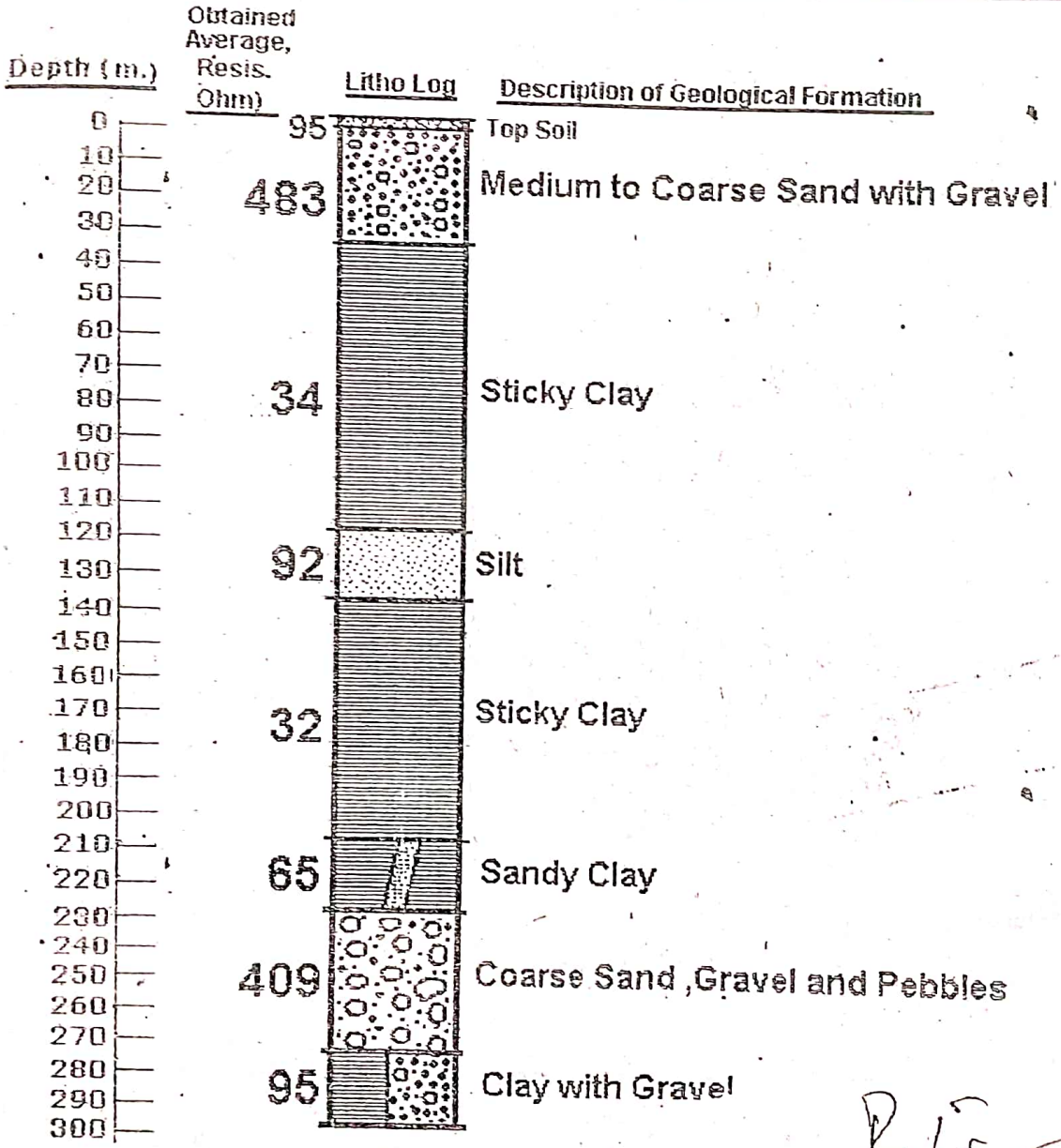
LITHOLOGICAL LOG.



LITHOLOGY

Client : AGRICULTURAL DEVELOPMENT BANK LIMITED
(TRAINING CENTRE)

Location : Bode, Bhaktapur-District.



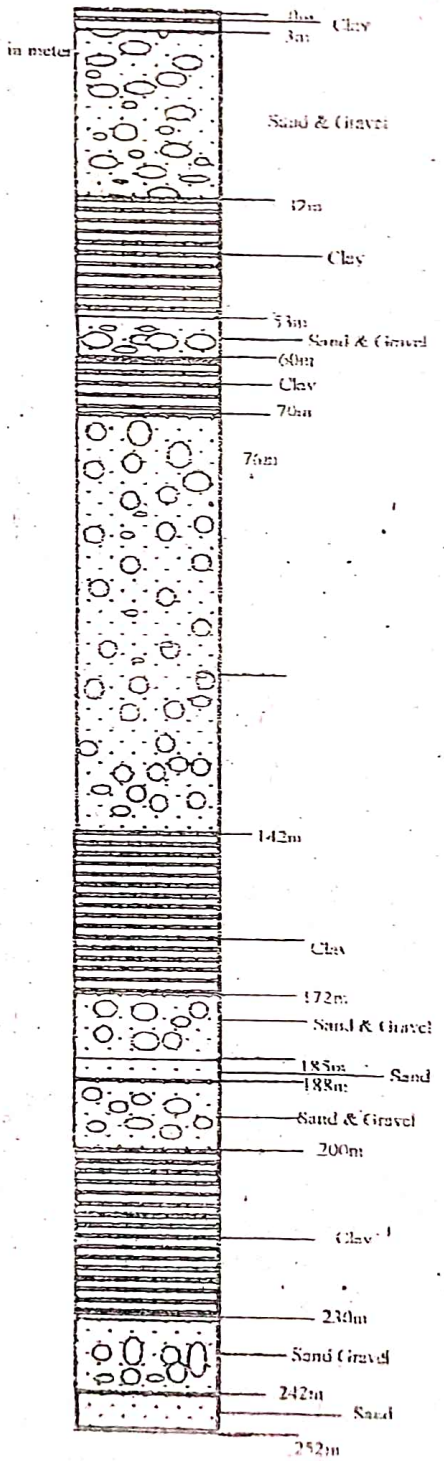
Drawn By

SAGARMATHA DRILLING COMPANY

NEPAL WATER SUPPLY CORPORATION

WATERWELL DRILLING AT BODE(BODE BH R5) BHAKTAPUR

LITHOLOGICAL LOG



B.B. Wakhare

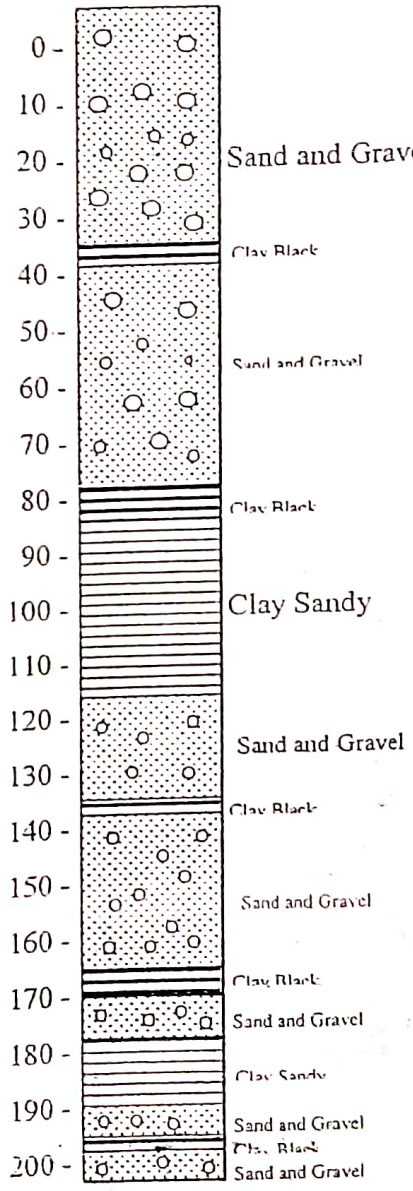
Consultant Hydrogeologist

350

LITHOLOGICAL LOG

ARTIFICIAL PILOT PROJECT (ARPP) OBSERVATION (WELL NO. 2)

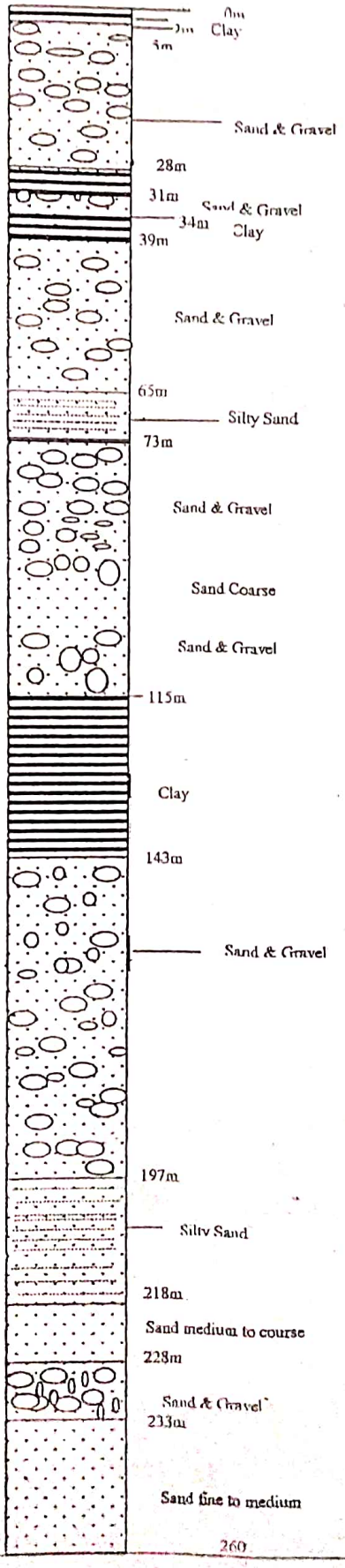
MULPANI, MANOHARA



SAGARMATHA DRILLING COMPANY (P.) LTD

WATERWELL DRILLING AT GANGABU BB-R3

LITHOLOGICAL LOG

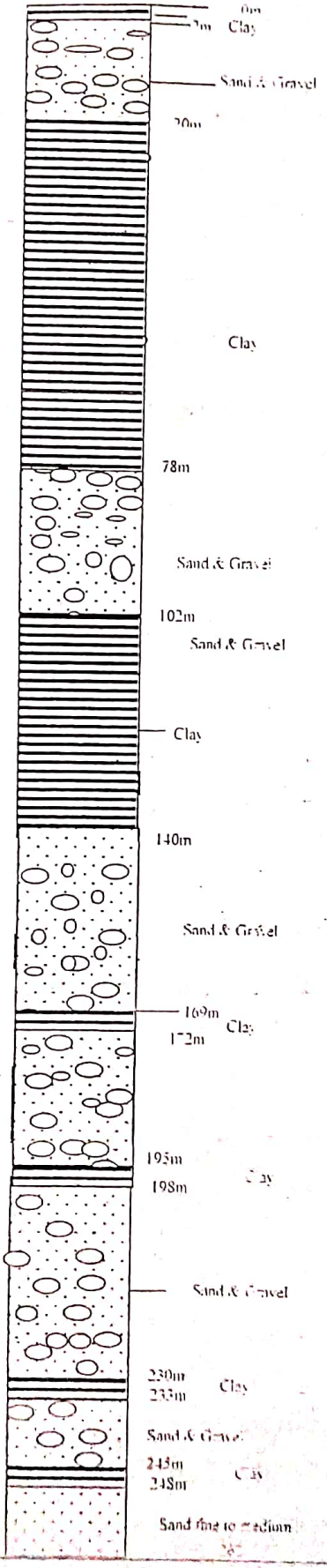


B Devkhorel
Consultant Hydrogeologist

SAGARMATHA DRILLING COMPANY (P.) LTD

WATERWELL DRILLING AT GANGABU BB-R5 Greenland

LITHOLOGICAL LOG



B Pickard

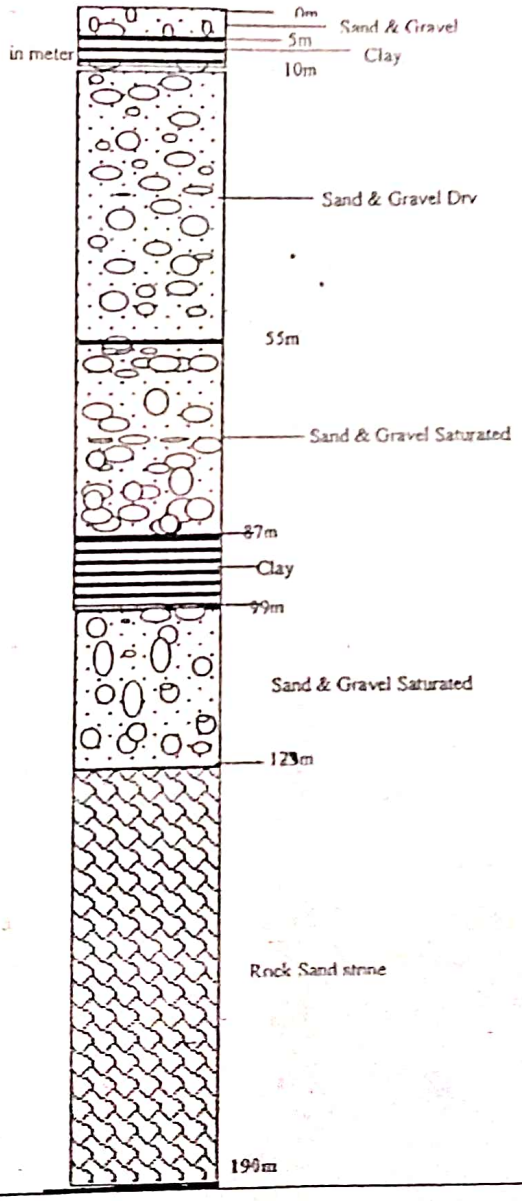
Consultant Hydrogeologist

SAGARMATHA DRILLING COMPANY

NEPAL WATER SUPPLY CORPORATION

WATERWELL DRILLING AT Bansbari(Treatment plant BB-R10)

LITHOLOGICAL LOG

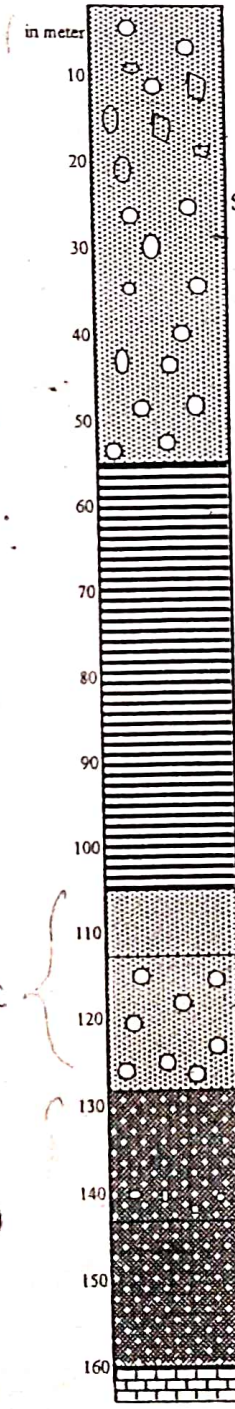


Bail

NEPAL WATER SUPPLY CORPORATION

WATERWELL DRILLING AT DHOBI KHOLA DK4 (92)

LITHOLOGICAL LOG



A

B

C

D

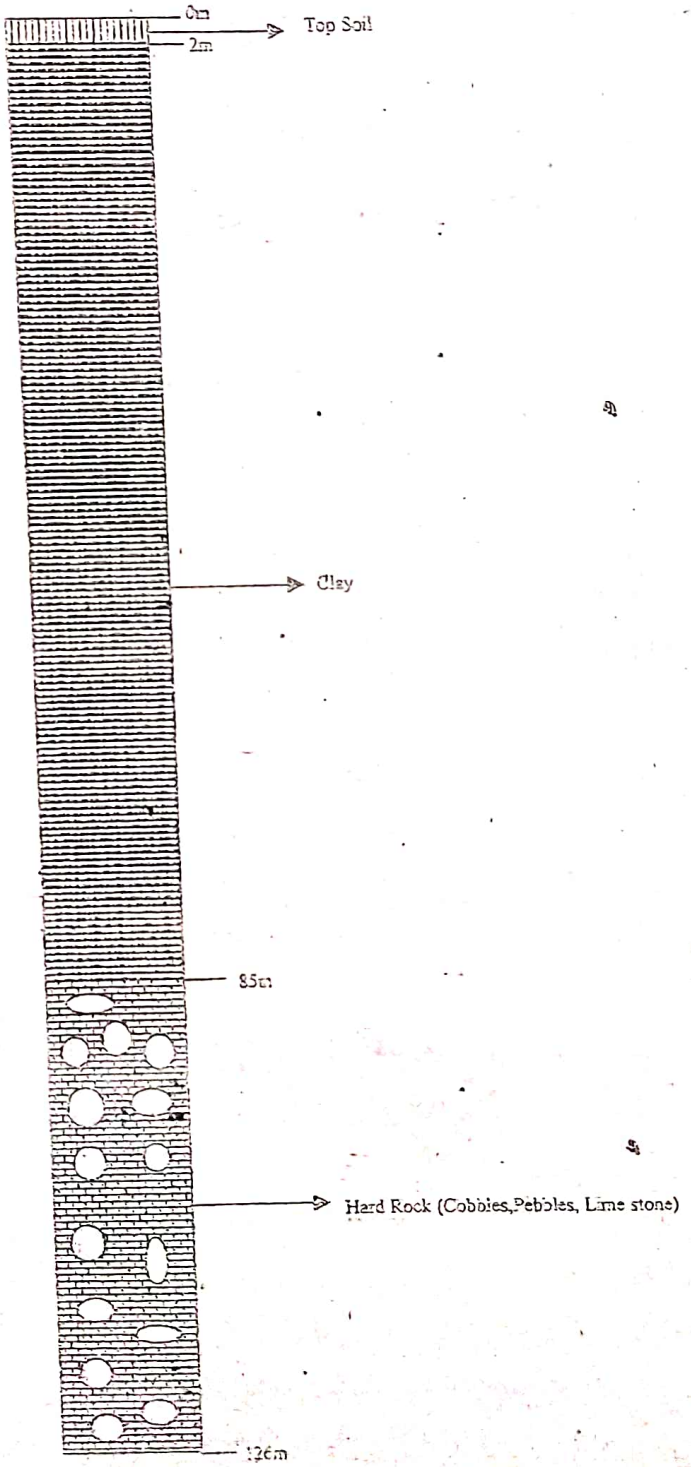
Screen depth

NATIONAL DRILLING COMPANY PVT. LTD.

CE CONSTRUCTION PVT. LTD.(PRIME COLONY)

WATERWELL DRILLING AT THADODHUNGA ,DHOBIGHAT

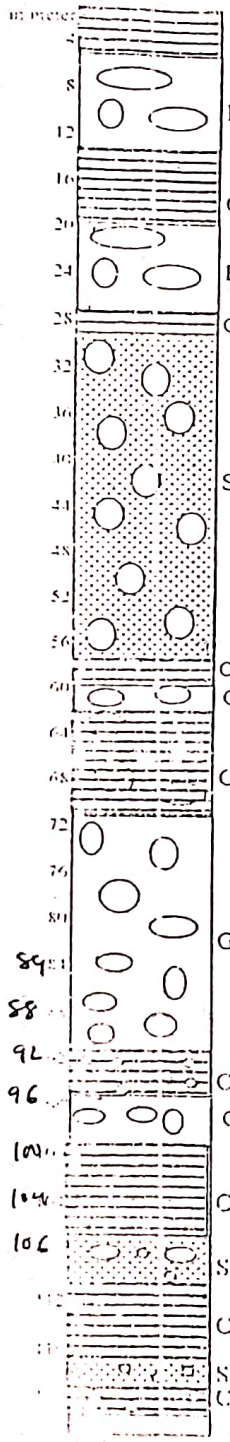
LITHOLOGICAL LOG



RAYBOT SPRINGS MINERAL WATER PVT. LTD.

WATER WELL DRILLING AT CHANLAKHEL VDC

LITHOLOGICAL LOG



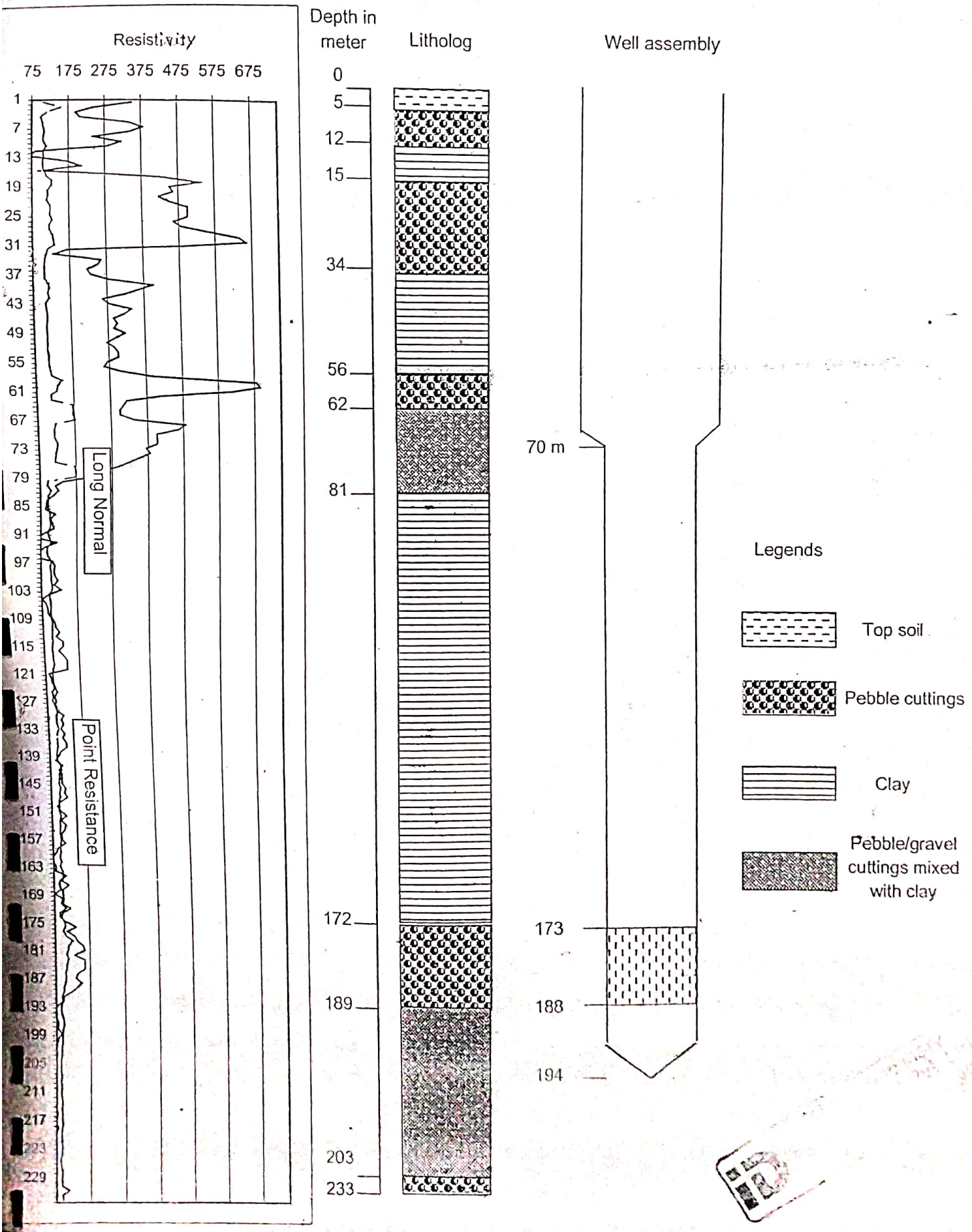
(43)

cation : Sunakothi (Civil Homes)

Logging date :2061/5/23

ling started on : 061/5/1

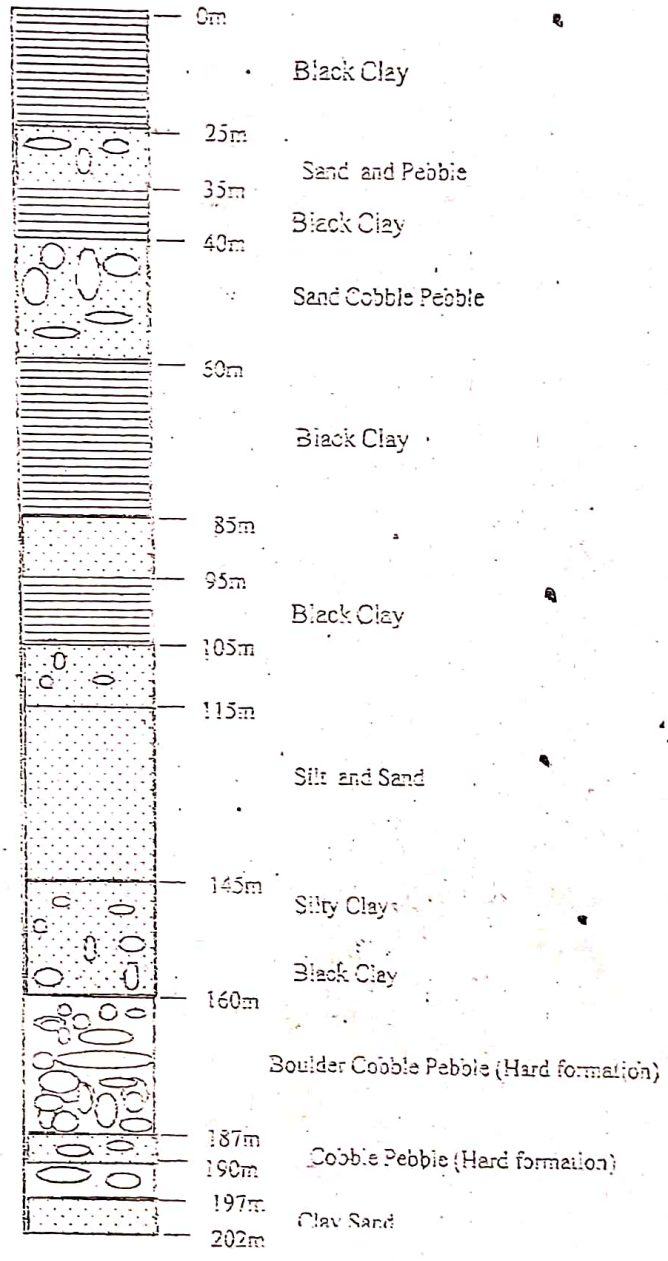
Type : Vol Drill (Model-180)



GEOCE GROUNDWATER DEVELOPMENT COMPUNY (P.) LTD

WATERWELL DRILLING AT DHAPAKHEL, LALITPUR

LITHOLOGICAL LOG



RIGIONAL MONITARING & SUPERVISION OFFICE

SINAMANGAL, KATHAMANDU

(OLD NAIKAP WATER SUPPLY PROJECT)

Water well Drilling at Old Naikap, Kathamandu

Lithological Log

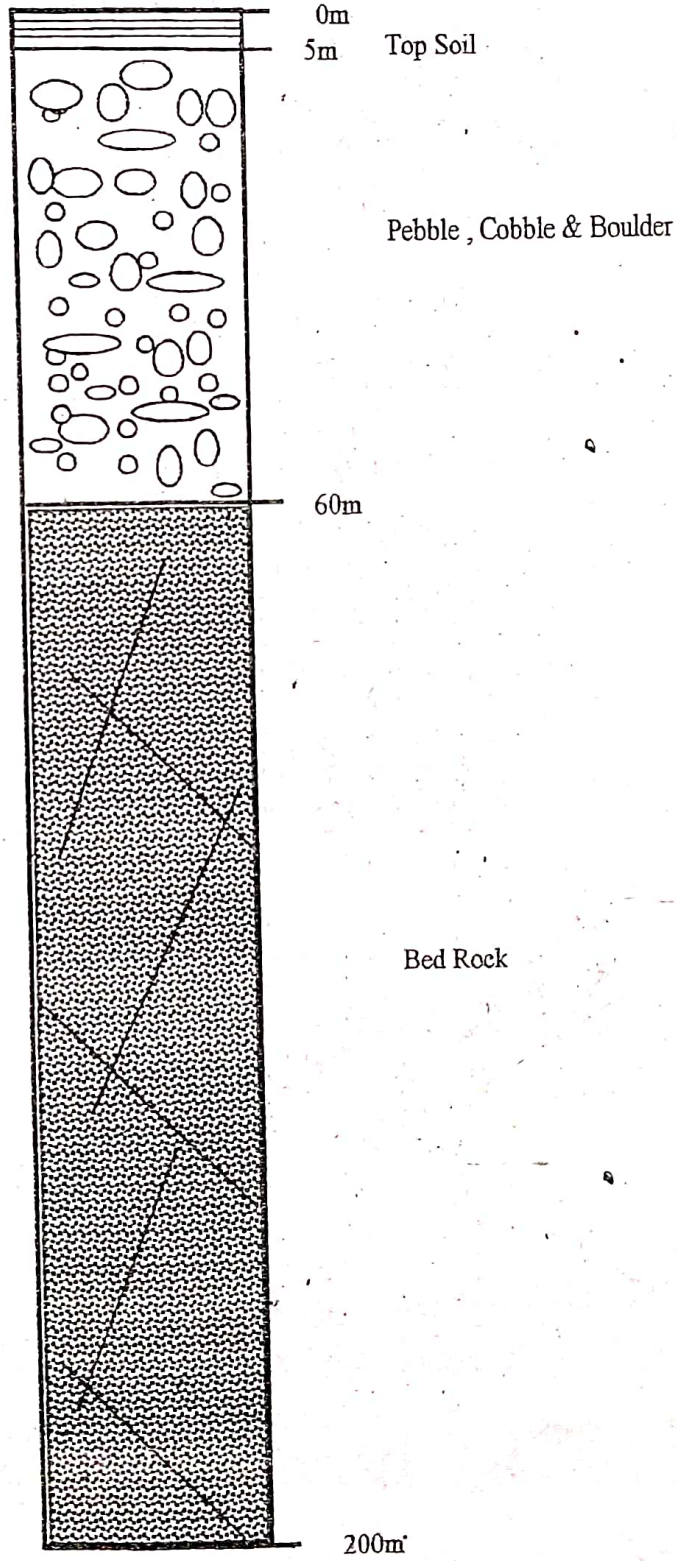
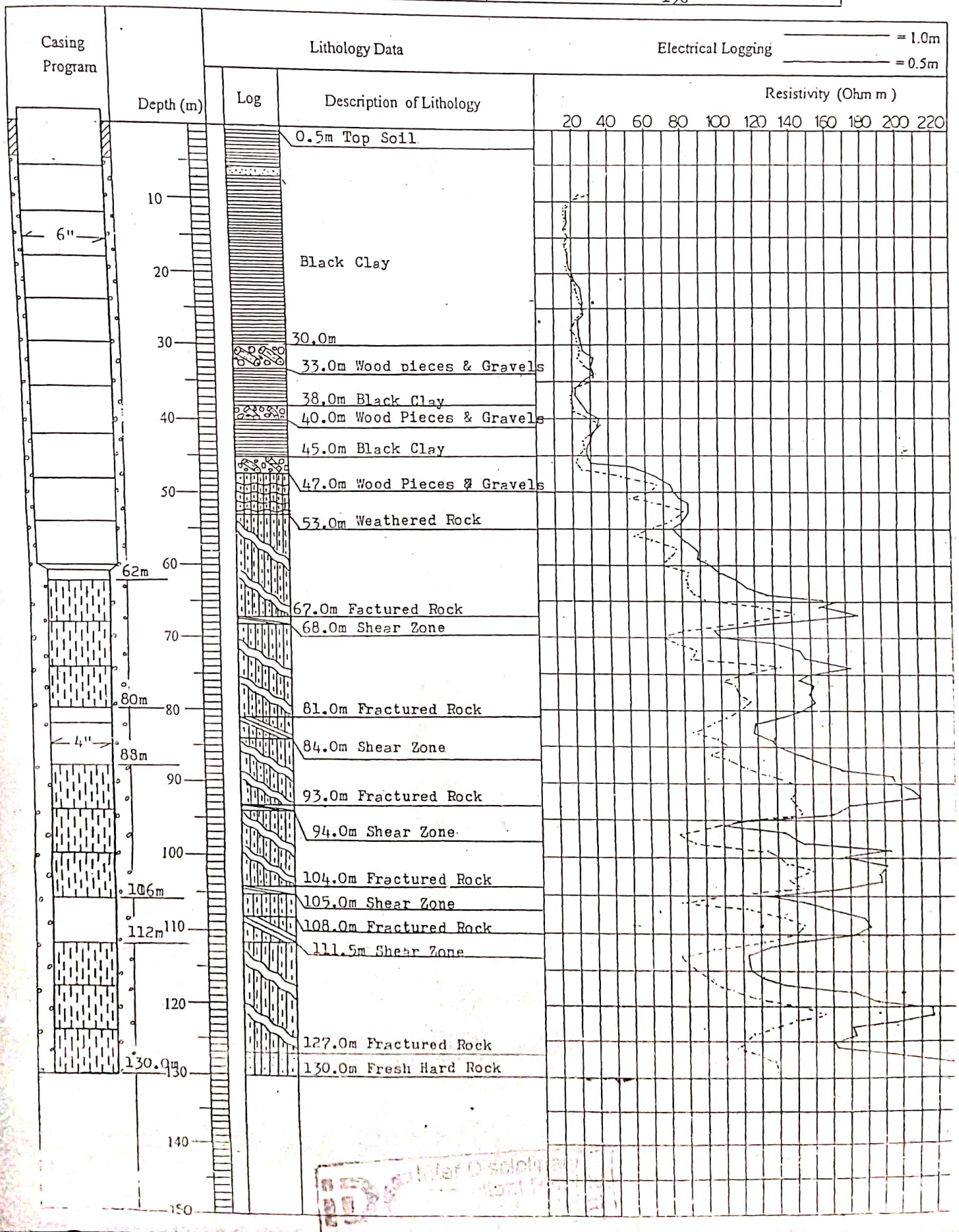


Fig: 1

WELL LOG

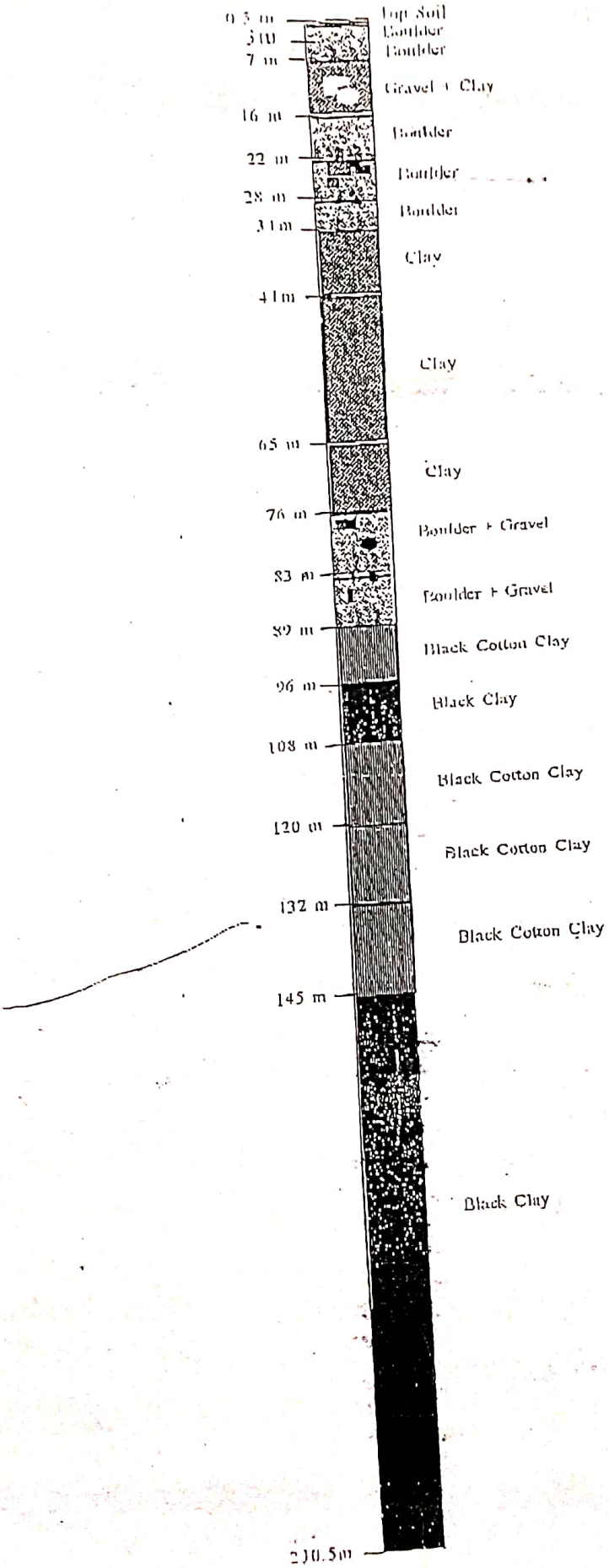
Data No.

PROJECT NAME	Modern Indian School		WELL NO
AREA AND LOCATION	Chobhar		
ELEVATION		LATITUDE	LONGITUDE
TOTAL DEPTH	130.0m	DRILLING RIG	KØKEN FSW-7T
DRILLING STARTED	17th Jan 2001	DRILLED BY	G.K. Pant
WELL COMPLETED	12th Feb. 2001	LOGGED BY	G.K. Pant
STATIC WATER LEVEL	7.0m	WATER TEMPERATURE	
DYNAMIC WATER LEVE	27.52m	CONDUCTIVITY	865 µS/mS/cm
MAXIMUM DISCHARGE	700L/min(1008m3/d)	pH	7.9
SPECIFIC CAPACITY	35.67 m3/d/m	TOTAL HARDNESS	156



ap 87

Lithological Log of Sunakothi well



GIDCE GROUNDWATER DEVELOPMENT COMPUNY (P.) LTD

WATERWELL DRILLING AT DHAPAKHEL, LALITPUR

LITHOLOGICAL LOG